PATENT ABSTRACTS OF JAPAN

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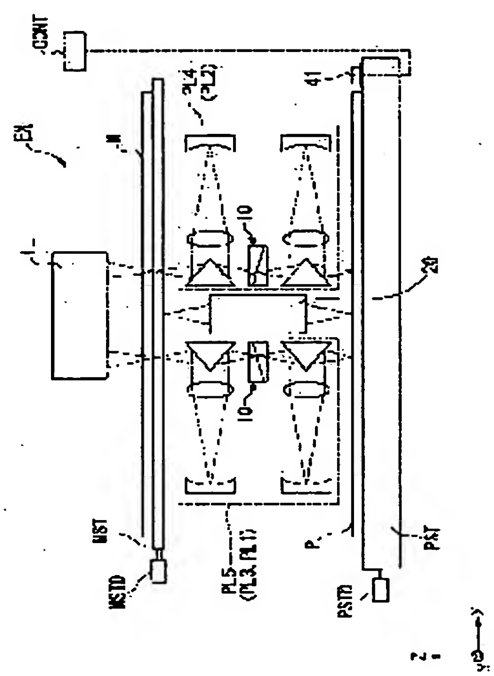
(54) ALIGNER AND EXPOSURE METHOD



(57)Abstract:

PROBLEM TO BE SOLVED: To offer an aligner and an exposure method which can continuously change or adjust the image focus location and image surface of a projection optical system with high accuracy to perform accurate exposure processing.

SOLUTION: This scanning aligner EX synchronously moves a mask M lit by exposure light and a photosensitive substrate P, while projecting and exposing the pattern image of the mask M on the photosensitive substrate P via projection optical systems PL1 through PL5. The equipment is provided with an image surface adjustment unit 10 which adjusts the position of the pattern image surface in the Z-axis direction along the light path of exposure light, and at the same time, adjusts the inclination of the pattern image surface.

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CLAIMS

[Claim(s)]
[Claim 1] The aligner characterized by to have the image surface adjusting device which adjusts the image surface inclination of said pattern image while adjusting the location of the image surface of said pattern in the direction which intersects perpendicularly with this image surface on the optical path of said exposure light in the aligner which carries out projection exposure of the pattern image of said mask through projection optics at said sensitization substrate, carrying out the synchronized drive of the mask and the sensitization substrate which are illuminated with exposure light.
[Claim 2] Said image surface adjusting device has the 1st inclined plane. The 1st optical member which can penetrate said exposure light, It has the 2nd inclined plane prepared so that said 1st inclined plane may be countered. The 2nd optical member which can penetrate said exposure light, The aligner according to claim 1 characterized by having a pivotable driving gear for the non-contact equipment which said the 1st inclined plane and said 2nd inclined plane are made to counter by non-contact, and said 1st optical member and said 2nd optical member relatively [circumference / of the optical axis of said optical path].
[Claim 3] Said image surface adjusting device is an aligner according to claim 1 or 2 characterized by equipping the circumference of the optical axis of said optical path which becomes by the wedge mold optical member of a pair, and penetrates the wedge mold optical member of said pair with the slewing gear which makes each pivotable relatively.
[Claim 4] Said image surface adjusting device is an aligner of claim 1-3 characterized by being prepared near said mask or said sensitization substrate given in any 1 term.
[Claim 5] Said image surface adjusting device is an aligner of claim 1-3 characterized by being prepared in a location [**** / optical almost] to said mask or said sensitization substrate given in any 1 term.
[Claim 6] It is the aligner of claim 1-5 characterized by establishing two or more said projection optics, and forming said image surface adjusting device corresponding to each of two or more of said projection optics given in any 1 term.
[Claim 7] Said image surface adjusting device is an aligner of claim 1-6 characterized by having the control section which carries out drive control based on the measurement result of the bending sensor which measures the amount of bending of said mask as a result of picturizing the pattern prepared in said mask by the image pick-up sensor formed in the substrate stage in which said sensitization substrate is laid given in any 1 term.
[Claim 8] Said control section is an aligner according to claim 7 characterized by controlling said image surface adjusting device based on the amount of deflections of said mask.
[Claim 9] Said control section is an aligner according to claim 7 or 8 characterized by controlling the amount of amendments in said image surface adjusting device to compensate for said synchronized drive of said mask and said sensitization substrate.
[Claim 10] Said control section is an aligner according to claim 9 characterized by having memorized beforehand the amount of amendments in said image surface adjusting device amended to compensate for said synchronized drive of said mask and said sensitization substrate as a control map.
[Claim 11] In the exposure approach which carries out projection exposure of the pattern image of said mask through projection optics at said sensitization substrate, carrying out the synchronized

drive of the mask and sensitization substrate which are illuminated with exposure light With the migration to which the synchronized drive of the 1st step which adjusts the image surface inclination of said pattern image while adjusting the location of the direction of an optical axis of the image surface of said pattern, and said mask and said sensitization substrate is carried out The exposure approach characterized by including the 2nd step to which the amount of adjustments adjusted at said 1st step in connection with said synchronized drive is changed.
[Claim 12] The exposure approach according to claim 11 characterized by having the 3rd step which measures beforehand said amount of adjustments changed in connection with said synchronized drive by said 2nd step before said synchronized drive.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the aligner and the exposure approach of carrying out projection exposure of the pattern image of a mask at a sensitization substrate, carrying out the synchronized drive of a mask and the sensitization substrate.
[0002]
[Description of the Prior Art] Electron devices, such as a liquid crystal display device and a semiconductor device, are manufactured by the technique of the so-called photolithography which imprints the pattern prepared in the mask on a sensitization substrate. The aligner used at this photolithography process has the substrate stage which lays the mask stage and sensitization substrate which lay the mask which has a pattern and carry out two-dimensional migration, and carries out two-dimensional migration, and it carries out projection exposure of the pattern prepared in the mask through projection optics at a sensitization substrate, moving serially on a mask stage and a substrate stage. Two kinds of scanning aligners which imprint the pattern of a mask on a sensitization substrate continuously are mainly known, carrying out the synchronous scan of the package mold aligner which imprints the whole pattern of a mask on a sensitization substrate at coincidence, and a mask stage and a substrate stage as an aligner. Among these, in case a liquid crystal display device is manufactured, the scanning aligner is mainly used from the demand of enlargement of a viewing area.
[0003] There is the so-called scanning aligner (multi-lens scan mold aligner) of the multi-lens method arranged so that it may overlap in the direction in which a scanning direction and the edges of an adjacent projection field cross at right angles among the scanning aligners so that an adjacent projection field may carry out specified quantity displacement of two or more projection optics in a scanning direction. The scanning aligner of a multi-lens method is equipment which exposes the pattern prepared in the mask through two or more of said projection optics which illuminated the mask in the lighting field of the shape of two or more slit, carried out the synchronous scan of a mask and the sensitization substrate in the direction which intersects perpendicularly to the array direction of the lighting field, and was established corresponding to each of two or more lighting fields on a sensitization substrate.
[0004] Here, since it is desirable to be set as a location [****] about projection optics at the time of exposure processing as for the front face (pattern side) of a mask, and the front face (exposure side) of a sensitization substrate, exposure processing of each of a mask and a sensitization substrate is carried out, attitude control being carried out by leveling equipment. Leveling equipment has two or more actuators displaced in the direction in alignment with the optical axis of projection optics, and by driving each of an actuator suitably, it rotates to the circumference of biaxial [within the field which intersects perpendicularly with an optical axis / rectangular] while it shifts a mask or a sensitization substrate in the direction in alignment with the optical axis of projection optics.
[0005] By the way, irregularity exists in the front face of a mask and a sensitization substrate according to the flatness of this mask and the sensitization substrate itself, generating of bending resulting from the maintenance condition of a stage, etc. Therefore, if it sees locally, a mask and a sensitization substrate may not serve as conjugate about projection optics.
[0006] So, exposure processing was performed in the former, adjusting so that the distance (focal

error) of the direction which meets the optical axis of each image formation location of two or more projection optics and the front face of a sensitization substrate by carrying out the synchronous scan of a mask and the sensitization substrate may be reduced on the average leveling equipment performing attitude control, such as a sensitization substrate.

[0007]

[Problem(s) to be Solved by the Invention] However, the problem described below came to arise on the above-mentioned conventional technique. that is, although surely the focal error in each location corresponding to two or more projection optics which can be set on a sensitization substrate by performing adjustment which reduces the focal error of two or more projection optics which boils, respectively and can be set on the average with leveling equipment is reduced, it may still remain and it may be that it is restricted to the further highly-precise-izing of the device manufactured, and high integration Generating of the irregularity produced on the front face of the mask resulting from bending and a sensitization substrate is remarkable, and it is becoming impossible furthermore, to be unable to respond by leveling control with enlargement of a mask in recent years and a sensitization substrate.

[0008] By the way, the technique of adjusting the image formation location of projection optics and reducing a focal error is conventionally known by forming an parallel flat-surface glass plate in the optical axis of projection optics. However, in an parallel flat-surface glass plate, since the image formation location of projection optics cannot be adjusted continuously, when performing exposure processing, carrying out the synchronous scan of the concavo-convex mask which is not uniform and a concavo-convex sensitization substrate, the position error of the image formation location of projection optics, and the image surface and the front face of the sensitization substrate to scan cannot be reduced.

[0009] It aims at offering the aligner and the exposure approach of this invention having been made in view of such a situation, and carrying out modification adjustment of the image formation location and the image surface of projection optics continuously with high degree of accuracy, and precision improving exposure processing.

[0010]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the configuration of the following matched with drawing 1 shown in the gestalt of operation - drawing 17 is used for this invention. In the aligner the aligner (EX) of this invention carries out projection exposure of the pattern image of a mask (M) through projection optics (PL1-PL5) at a sensitization substrate (P), carrying out the synchronized drive of the mask (M) and sensitization substrate (P) which are illuminated with exposure light It is characterized by having the image surface adjusting device (10) which adjusts the image surface inclination of a pattern image while adjusting the location of the image surface of a pattern in the direction (Z) which intersects perpendicularly with this image surface on the optical path of exposure light.

[0011] Since according to this invention it had the image surface adjusting device which adjusts the image surface inclination of a pattern image while adjusting the location of the image surface of a pattern in the direction which intersects perpendicularly with this image surface, an image surface adjusting device can reduce a focal error by adjusting the location of the image surface of a pattern. Moreover, even if irregularity exists in the front face of a sensitization substrate or a mask by adjusting the image surface inclination of a pattern image, the image surface of a pattern and the front face of a sensitization substrate can be made in agreement. Therefore, even when performing exposure processing, carrying out the synchronous scan of a mask and the sensitization substrate, scan exposure can be performed, reducing the position error of the image surface and the front face of a sensitization substrate.

[0012] In this case, an image surface adjusting device (10) It has the 1st inclined plane (1b). The 1st optical member (1) which can penetrate exposure light, It has the 2nd inclined plane (2a) prepared so that the 1st inclined plane (1b) may be countered. The 2nd optical member (2) which can penetrate exposure light, It is the configuration equipped with a pivotable driving gear (5 6) for the non-contact equipment (11) which the 1st inclined plane (1b) and 2nd inclined plane (2a) are made to counter by non-contact, the 1st optical member (1), and the 2nd optical member (2) relatively [circumference / of the optical axis of an optical path]. Since it can set up so that each of the optical

path length of the exposure light corresponding to a different location called the center section and edge of the image surface may be differed, when this rotates relatively each of the 1st optical member which has an inclined plane, respectively, and the 2nd optical member, the image surface of a pattern can be inclined to an optical axis. Therefore, since what is necessary is just to make the image surface incline according to this irregularity even if irregularity exists in the sensitization substrate, scan exposure can be performed, reducing the position error of the front face of a sensitization substrate, and the image surface.
[0013] In the exposure approach the exposure approach of this invention carries out projection exposure of the pattern image of a mask (M) through projection optics (PL1-PL5) at a sensitization substrate (P), carrying out the synchronized drive of the mask (M) and sensitization substrate (P) which are illuminated with exposure light With the 1st step which adjusts the image surface inclination of a pattern image while adjusting the location of the direction of an optical axis of the image surface of a pattern, and the migration to which the synchronized drive of a mask (M) and the sensitization substrate (P) is carried out It is characterized by including the 2nd step to which the amount of adjustments adjusted at the 1st step in connection with a synchronized drive is changed.
[0014] According to this invention, even if it faces carrying out exposure processing and irregularity exists in the front face of a sensitization substrate or a mask, carrying out the synchronous scan of a mask and the sensitization substrate in connection with a synchronized drive by adjusting an image formation location and the image surface inclination of a pattern image, exposure processing can be performed, making the image surface of a pattern, and the front face of a sensitization substrate mostly in agreement. Therefore, accurate exposure processing can be performed.
[0015]
[Embodiment of the Invention] Hereafter, it explains, referring to a drawing about the aligner and the exposure approach of this invention. The outline block diagram in which drawing 1 shows 1 operation gestalt of the aligner of this invention, and drawing 2 are outline perspective views.
[0016] The illumination-light study system IL in which Aligner EX illuminates Mask M with exposure light in drawing 1 and drawing 2 The mask stage MST which supports Mask M, and two or more projection optics PL1-PL5 which projects the pattern image of the mask M illuminated with exposure light on the sensitization substrate P, It has the mask side laser interferometers 39a and 39b which detect the location of a mask stage MST using the substrate stage PST and laser beam which support the sensitization substrate P, and the substrate side laser interferometers 43a and 43b which detect the location of the substrate stage PST using a laser beam. The projection optics in this operation gestalt is five, PL1-PL5, and the illumination-light study system IL illuminates Mask M in the lighting field corresponding to each of projection optics PL1-PL5. Moreover, the sensitization substrate P applies a resist (sensitization agent) to a glass plate.
[0017] The aligner EX in this operation gestalt is a scanning aligner which carries out projection exposure of the pattern of Mask M through projection optics PL at the sensitization substrate P, carrying out the synchronized drive of the mask M currently supported by the mask stage MST and the sensitization substrate P currently supported by the substrate stage PST. In the following explanation, the direction of an optical axis of projection optics PL is made into Z shaft orientations, make the direction of a synchronized drive of Mask M and the sensitization substrate P (scanning direction) into X shaft orientations in a direction perpendicular to Z shaft orientations, and let the direction (non-scanning direction) which intersects perpendicularly with Z shaft orientations and X shaft orientations be Y shaft orientations.
[0018] Although the illumination-light study system IL did not illustrate The light guide which carries out equipartition of the flux of light injected from two or more light sources and two or more light sources, and injects it once gathering, The optical integrator which changes the flux of light from a light guide into the flux of light (exposure light) which has uniform illuminance distribution, It has the blind which has opening for operating the exposure light from an optical integrator orthopedically in the shape of a slit, and the condensing lens which carries out image formation of the exposure light which passed the blind on Mask M. The exposure light from a condensing lens illuminates Mask M in the lighting field of the shape of two or more slit. A mercury lamp is used for the light source in this operation gestalt, and g line (436nm) which is wavelength required for exposure, h line (405nm), i line (365nm), etc. are used with a non-illustrated wavelength selection

filter as an exposure light.
[0019] The mask stage MST which supports Mask M is formed movable, and it has the long stroke to X shaft orientations, and the stroke of the predetermined distance to Y shaft orientations which intersect perpendicularly with a scanning direction in order to perform scan exposure of a single dimension. As shown in drawing 1 , the mask stage mechanical component MSTD is connected to the mask stage MST, and the mask stage MST is movable to X shaft orientations and Y shaft orientations by the drive of the mask stage mechanical component MSTD. The mask stage mechanical component MSTD is controlled by the control unit (control section) CONT.
[0020] As shown in drawing 2 , the mask side laser interferometer is equipped with X laser interferometer 39a which detects the location in X shaft orientations of a mask stage MST, and Y laser interferometer 39b which detects the location in Y shaft orientations of a mask stage MST. X migration mirror 38a which extends in Y shaft orientations is prepared in the edge by the side of +X of a mask stage MST. On the other hand, Y migration mirror 38b which extends in X shaft orientations is prepared in the edge by the side of +Y of a mask stage MST so that it may intersect perpendicularly with X migration mirror 38a. X laser interferometer 39a counters and is arranged at X migration mirror 38a, and Y laser interferometer 39b counters and is arranged at Y migration mirror 38b.
[0021] X laser interferometer 39a irradiates a laser beam at X migration mirror 38a. The light (reflected light) generated in X migration mirror 38a by the exposure of a laser beam is received by the detector inside X laser interferometer 39a. X laser interferometer 39a detects the location of X migration mirror 38a, i.e., the location in X shaft orientations of a mask stage MST (as a result, the mask M), on the basis of the location of an internal reference mirror based on the reflected light from X migration mirror 38a.
[0022] Y laser interferometer 39b irradiates a laser beam at Y migration mirror 38b. The light (reflected light) generated in Y migration mirror 38b by the exposure of a laser beam is received by the detector inside Y laser interferometer 39b. Y laser interferometer 39b detects the location of Y migration mirror 38b, i.e., the location in Y shaft orientations of a mask stage MST (as a result, the mask M), on the basis of the location of an internal reference mirror based on the reflected light from Y migration mirror 38b.
[0023] laser interferometers 39a and 39b -- each detection result is outputted to a control unit CONT. a control unit CONT -- laser interferometers 39a and 39b -- based on each detection result, a mask stage MST is driven through the mask stage mechanical component MSTD, and position control of Mask M is performed.
[0024] Incidence of the exposure light which penetrated Mask M is carried out to each of projection optics PL1-PL5. Each of projection optics PL1-PL5 carries out projection exposure of the image of the pattern which exists in the lighting field of Mask M at the sensitization substrate P, and is arranged corresponding to each of the lighting field by the illumination-light study system IL. Projection optics PL1, PL3, and PL5 and projection optics PL2 and PL4 are alternately arranged by two trains. That is, each of the projection optics PL1-PL5 arranged alternately carries out the specified quantity variation rate of the ****** projection optics (for example, projection optics PL 1, and PL2, PL2 and PL3) to X shaft orientations, and is arranged. The exposure light which penetrated each of projection optics PL1-PL5 carries out image formation of the image of the pattern corresponding to the lighting field of Mask M to the projection field to which it differs on the sensitization substrate P currently supported by the substrate stage PST. The pattern of the mask M of a lighting field has a predetermined image formation property, and is imprinted on the sensitization substrate P with which the resist was applied.
[0025] The substrate stage PST which supports the sensitization substrate P is formed movable, and it has the long stroke to X shaft orientations, and the long stroke to Y shaft orientations for carrying out step migration in the direction which intersects perpendicularly with a scanning direction in order to perform scan exposure of a single dimension. The substrate stage mechanical component PSTD containing a linear actuator is connected to the substrate stage PST (refer to drawing 1), and the substrate stage PST is movable by the drive of the substrate stage mechanical component PSTD to X shaft orientations, Y shaft orientations, and Z shaft orientations. Furthermore, the substrate stage PST is established in the circumference of the X-axis, the circumference of a Y-axis, and the

circumference of the Z-axis pivotable. By rotating to the circumference of the X-axis, and the circumference of a Y-axis, the substrate stage PST performs leveling control of the supported sensitization substrate P. The substrate stage mechanical component PSTD is controlled by the control unit CONT.

[0026] As shown in drawing 2 , the substrate side laser interferometer is equipped with X laser interferometer 43a which detects the location in X shaft orientations of the substrate stage PST, and Y laser interferometer 43b which detects the location in Y shaft orientations of the substrate stage PST. X migration mirror 42a which extends in Y shaft orientations is prepared in the edge by the side of +X of the substrate stage PST. On the other hand, Y migration mirror 42b which extends in X shaft orientations is prepared in the edge by the side of -Y of the substrate stage PST so that it may intersect perpendicularly with X migration mirror 42a. X laser interferometer 43a counters and is arranged at X migration mirror 42a, and Y laser interferometer 43b counters and is arranged at Y migration mirror 42b.

[0027] X laser interferometer 43a irradiates a laser beam at X migration mirror 42a. The light (reflected light) generated in X migration mirror 42a by the exposure of a laser beam is received by the detector inside X laser interferometer 43a. X laser interferometer 43a detects the location of X migration mirror 42a, i.e., the location in X shaft orientations of the substrate stage PST (as a result, the sensitization substrate P), on the basis of the location of an internal reference mirror based on the reflected light from X migration mirror 42a.

[0028] Y laser interferometer 43b irradiates a laser beam at Y migration mirror 42b. The light (reflected light) generated in Y migration mirror 42b by the exposure of a laser beam is received by the detector inside Y laser interferometer 43b. Y laser interferometer 43b detects the location of Y migration mirror 42b, i.e., the location in Y shaft orientations of the substrate stage PST (as a result, the sensitization substrate P), on the basis of the location of an internal reference mirror based on the reflected light from Y migration mirror 42b.

[0029] laser interferometers 43a and 43b -- each detection result is outputted to a control unit CONT. a control unit CONT -- laser interferometers 43a and 43b -- based on each detection result, the substrate stage PST is driven through the substrate stage mechanical component PSTD, and position control of the sensitization substrate P is performed.

[0030] As shown in drawing 2 , the alignment systems 49a and 49b which perform alignment of Mask M and the sensitization substrate P above the mask stage MST are formed. The alignment systems 49a and 49b evacuate from a lighting field at the time of scan exposure while they have become movable with the non-illustrated drive at Y shaft orientations and advance between the illumination-light study system IL and Mask M at the time of alignment processing. The alignment systems 49a and 49b detect the mask alignment mark (un-illustrating) currently formed in Mask M, and substrate alignment marks [which are formed in the sensitization substrate P / 52a-52d (refer to drawing 4)] location. The detection result of the alignment systems 49a and 49b is outputted to a control unit CONT. A control unit CONT performs position control of a mask stage MST and the substrate stage PST based on the detection result of the alignment systems 49a and 49b.

[0031] Furthermore, two or more mask marks (un-illustrating) used for the amount calculation of amendments of the various characteristics of image, such as a shift, rotation, and a scaling, are formed in Mask M. On the other hand, two or more substrate marks (un-illustrating) used for the sensitization substrate P for the amount calculation of amendments of the characteristic of image are formed.

[0032] As shown in drawing 1 , the focal sensor 20 is formed among two or more projection optics PL1-PL5. Two or more these focal sensors 20 are formed in accordance with Y shaft orientations, and with this operation gestalt, they are formed five so that it may mention later. The focal sensor 20 can measure a relative distance with Mask M, and a relative distance with the sensitization substrate P, and detects the location in Z shaft orientations of the sensitization substrate P currently supported by the location and the substrate stage PST in Z shaft orientations of the mask M currently supported by the mask stage MST. The detection result of the focal sensor 20 is outputted to a control unit CONT, and a control unit CONT performs position control of the substrate stage PST, as a result position control of the sensitization substrate P through the substrate stage mechanical component PSTD based on the detection result of the focal sensor 20.

[0033] In this operation gestalt, under control of a control device CONT, each of a mask stage MST and the substrate stage PST becomes independent by the mask stage mechanical component MSTD and the substrate stage mechanical component PSTD, and is movable. The synchronized drive of the mask stage MST which supported Mask M, and the substrate stage PST which supported the sensitization substrate P is carried out to X shaft orientations with the scan speed (synchronous passing speed) of arbitration to projection optics PL. Although a slit-like (trapezoidal shape) pattern image is projected on the sensitization substrate P and it is some mask patterns prepared in Mask M after the substrate stage PST has stood it still All the mask patterns prepared in Mask M are imprinted on the sensitization substrate P by carrying out the synchronous scan of the mask stage MST which supports Mask M, and the substrate stage PST which supports the sensitization substrate P to the lighting field and projection optics PL1-PL5 on Mask M.

[0034] Drawing 3 is the outline block diagram of projection optics PL 1 (PL2-PL5). Although only the thing corresponding to projection optics PL 1 is shown to drawing 3 by here, each of projection optics PL1-PL5 has the same configuration. Moreover, in this operation gestalt, projection optics is the optical system of actual size erecting system. As shown in drawing 3 , projection optics PL 1 is the configuration which combined 2 sets of Dyson mold optical system, and is equipped with the shift adjustment device 23, 2 sets of reflective refraction mold optical system 24 and 25, the image surface adjusting device 10, the non-illustrated field diaphragm, and the scaling adjustment device 27.

[0035] Incidence of the flux of light which penetrated Mask M is carried out to the shift adjustment device 23. The shift adjustment device 23 has two parallel flat-surface glass plates, and shifts the pattern image on the sensitization substrate P to X shaft orientations and Y shaft orientations with a non-illustrated driving gear by [of two parallel flat-surface glass plates] rotating to the circumference of Y shaft, and the circumference of the X-axis, respectively.

[0036] Incidence of the flux of light which penetrated the shift adjustment device 23 is carried out to reflective [the 1st set of] refraction mold optical system 24. The reflective refraction mold optical system 24 forms the middle image of the pattern of Mask M, and is equipped with the rectangular prism 28, the lens system 29, and the concave mirror 30.

[0037] The rectangular prism 28 is formed in the circumference of the Z-axis pivotable, and rotates to the circumference of the Z-axis with a non-illustrated driving gear. When a rectangular prism 28 rotates to the circumference of the Z-axis, the pattern image of the mask M on the sensitization substrate P rotates to the circumference of the Z-axis. That is, the rectangular prism 28 has the function as a rotation adjustment device.

[0038] The non-illustrated field diaphragm is arranged in the middle image position of the pattern formed of the reflective refraction mold optical system 24. A field diaphragm sets up the projection field on the sensitization substrate P. In this operation gestalt, a field diaphragm has opening of trapezoidal shape and the projection field on the sensitization substrate P is prescribed to trapezoidal shape by this field diaphragm (refer to drawing 4 sign 50a - 50e). Incidence of the flux of light which penetrated the field diaphragm is carried out to reflective [the 2nd set of] refraction mold optical system 25.

[0039] The reflective refraction mold optical system 25 is equipped with the rectangular prism 31 as a rotation adjustment device, the lens system 32, and the concave mirror 33 like the reflective refraction mold optical system 24. The pattern image of the mask M on the sensitization substrate P is rotated to the circumference of the Z-axis because a rectangular prism 31 also rotates to the circumference of the Z-axis by the drive of a non-illustrated driving gear and rotates.

[0040] The flux of light injected from the reflective refraction mold optical system 25 passes along the scaling adjustment device 27, and carries out image formation of the pattern image of Mask M by erection actual size on the sensitization substrate P. The scaling adjustment device 27 consists of three lenses, a plano-convex lens, a biconvex lens, and a plano-convex lens, and performs scale-factor (scaling) adjustment of the pattern image of Mask M by moving the biconvex lens located between a plano-convex lens and a plano-concave lens to Z shaft orientations with a non-illustrated driving gear.

[0041] Drawing 4 is the top view showing the sensitization substrate P and a projection field. As shown in drawing 4 , projection optics PL1-PL5 specifies the projection fields 50a-50e to trapezoidal

shape by the field diaphragm within projection optics. The projection fields corresponding to each of projection optics PL1, PL3, and PL5 are 50a, 50c, and 50e here, and the projection fields corresponding to each of projection optics PL2 and PL4 are 50b and 50d. Each of the projection fields 50a, 50c, and 50e is arranged in accordance with Y shaft orientations, and projection fields [50b and 50d] each is arranged in accordance with Y shaft orientations. And the projection fields 50a, 50c, and 50e and the projection fields 50b and 50d counter, and the surface (shorter side of the parallel sides of a pair) is arranged at X shaft orientations. Furthermore, as the edges (splice section) of an adjacent projection field show with a broken line, the parallel arrangement of each of the projection fields 50a-50e is carried out so that it may lay on top of Y shaft orientations, and it is set up so that the grand total of the width of face of the projection field in X shaft orientations may become almost equal. That is, it is set up so that the light exposure when carrying out scan exposure may become equal at X shaft orientations. By the splice section which each of the projection fields 50a-50e piles up, the change and illuminance change of optical aberration in the splice section become smooth. In addition, although the configuration of the projection fields 50a-50e of this operation gestalt is a trapezoid, you may be a hexagon, and a rhombus or a parallelogram.
[0042] Since the projection fields 50a, 50c, and 50e and the projection fields 50b and 50d are left and set as X shaft orientations in Aligner EX, the pattern extended to Y shaft orientations It is divided in time and spatially and is exposed as it is exposed in the projection fields 50b and 50d which set a certain time amount and bury the meantime, after the discontinuous projection fields 50a, 50c, and 50e separated spatially first are exposed.
[0043] It returns to drawing 1 and the image pick-up sensor 41 is arranged on the substrate stage PST by the almost same height as the exposure side of the sensitization substrate P. The image pick-up sensor 41 is a sensor which detects the information (an illuminance, contrast) about the quantity of light of the exposure light on the sensitization substrate P, is constituted by the CCD sensor, and detects the illuminance of the exposure light of the location 50a-50e corresponding to each of the projection optics PL1-PL5 on the sensitization substrate P, i.e., projection fields, two-dimensional. The image pick-up sensor 41 is installed in the height of the same flat surface as the sensitization substrate P with the guide shaft (un-illustrating) arranged by Y shaft orientations on the substrate stage PST, and is formed in Y shaft orientations by the image pick-up sensor mechanical component movable. The image pick-up sensor 41 is scanned in advance of exposure of 1 time or multiple times under each of the projection fields 50a-50e corresponding to projection optics PL1-PL5 by migration of X shaft orientations of the substrate stage PST, and migration of Y shaft orientations by the image pick-up sensor mechanical component. Therefore, the illuminance of the projection fields 50a-50e on the sensitization substrate P is detected by the image pick-up sensor 41 two-dimensional. The illuminance of the exposure light detected by the image pick-up sensor 41 is outputted to a control unit CONT. A control device CONT can detect the location of the image pick-up sensor 41 with each amount of drives of the substrate stage mechanical component PSTD and an image pick-up sensor mechanical component. Moreover, a control unit CONT can search for each configuration of each projection fields 50a-50e based on the detection result of the image pick-up sensor 41.
[0044] And the image pick-up sensor 41 can detect the image formation location (focal location) and the image surface of projection optics PL1-PL5 by detecting the contrast of the image pick-up fields 50a-50e two-dimensional. That is, while arranging the image pick-up sensor 41 to projection field 50a corresponding to projection optics PL 1, the contrast of the pattern of Mask M is measured, moving this sensor 41 to Z shaft orientations the whole substrate stage PST. A control unit CONT makes the location in Z shaft orientations which can acquire the maximum contrast the image formation location of projection optics PL 1 based on the result picturized by the image pick-up sensor 41. Moreover, since the image pick-up sensor 41 can detect the contrast of projection field 50a two-dimensional, it can also detect the location of the image surface of the pattern through projection optics PL 1. For example, if the pattern image in projection field (pattern image) 50a is contrast uniform in a field, the image surface of projection optics PL 1 and the run flat surface of the substrate stage PST to which the image pick-up sensor 41 was moved show the parallel thing. On the other hand, when uniform contrast is not acquired in the field of projection field 50a, it is shown that the image surface of projection optics PL 1 inclines to the run flat surface of the substrate stage PST. Moreover, the location (image formation location) of the exact image surface is measurable by

moving the image pick-up sensor 41 to Z shaft orientations of projection optics PL 1, and detecting a place with the sufficient contrast of a pattern.
[0045] Moreover, the image pick-up sensor 41 can detect the amount of bending of Mask M by detecting the contrast of the pattern of Mask M. namely, -- since the contrast of the pattern of the projection fields 50a-50e which boils, respectively and can be set becomes less uniform when the mask M currently supported by the mask stage MST has bent -- an image pick-up sensor 41 -- using -- projection fields 50a-50e -- change of the location of the image surface which the projection fields 50a-50e are alike, respectively, and corresponds can measure by detecting the best place of the contrast of the pattern in each field. Here, it becomes possible from the relation between the location of a pattern, and an image surface location to predict bending of a common mask and an image surface location by memorizing the relation between the location which measured the pattern of Mask M, and the image surface location of the projection optics searched for by detection to a control unit CONT (or storage linked to a control unit CONT). In addition, the formation of a form status change, a shift, rotation, etc. of a projection field are measurable to coincidence by measuring one side of the edge of the configuration of opening of a field diaphragm, i.e., the configuration of a projection field, two or more points using the image pick-up sensor 41.
[0046] Next, the focal sensor 20 is explained, referring to drawing 1 and drawing 4 . Are a part between Mask M and the sensitization substrate P, and between the projection optics PL1, PL3, and PL5 corresponding to the projection fields 50a, 50c, and 50e, and the projection optics PL2 and PL4 corresponding to the projection fields 50b and 50d The case where it measures by two or more focal sensors 20 arranged by Y shaft orientations in the location corresponding to the location shown with the cross line "+" by drawing 4 is shown. Five focal sensors 20 are formed in this operation gestalt, and it is ********. these focal sensors 20 irradiate the detection light which has the wavelength of the front face (pattern side) of Mask M, and the front face (exposure side) of the sensitization substrate P which is alike, respectively, receives and does not expose a resist, and detect the location in Z shaft orientations of the front face of Mask M, and the front face of the sensitization substrate P by detecting the light (reflected light) generated with Mask M and the sensitization substrate P. The detection result of the focal sensor 20 is outputted to a control unit CONT.
[0047] And, scanning the substrate stage PST which supported the mask stage MST which supported Mask M, and the sensitization substrate P to X shaft orientations Based on each detection result of the focal sensor 20 of these plurality, by detecting the location in Z shaft orientations of Mask M and the sensitization substrate P by the predetermined sampling pitch in X shaft orientations the mask M in the location corresponding to X axial seat label specified with the feed per revolution of a stage, and Y axial seat label specified by the installation location in Y shaft orientations of the focal sensor 20, and the sensitization substrate P -- the surface data which consist of a location of each Z shaft orientations can be obtained.
[0048] these masks M and the surface data of the sensitization substrate P -- Mask M and the sensitization substrate P -- the mask M resulting from the maintenance condition of each flatness, a mask stage MST, and the substrate stage PST bend and according to the ununiformity of delivery of a stage etc., and the sensitization substrate P -- it is data in which the irregularity of each front face is shown. Storage maintenance of this surface data is carried out at the non-illustrated storage linked to a control unit CONT or a control unit CONT.
[0049] In addition, it may be made to perform measurement of the focal sensor 20 continuously. Furthermore, by asking for the correspondence relation between the image surface location of the mask M for which it asked previously, and the surface location of Mask M, based on the location of the front face of Mask M, it cannot measure serially but ** can also guess an image surface location easily.
[0050] As shown in drawing 3 , on the optical path between 2 sets of reflective refraction mold optical system 24 and 25 of projection optics PL1-PL5, the image surface adjusting device 10 which adjusts the image formation location of projection optics PL 1 and the inclination of the image surface is formed, respectively. Here, the image surface adjusting device 10 is formed near the location in which the middle image by the reflective refraction mold optical system 24 is formed. That is, the image surface adjusting device 10 is formed in the location [**** / almost] to Mask M and the sensitization substrate P. The image surface adjusting device 10 is formed corresponding to

each of two or more projection optics PL1-PL5.
[0051] Drawing 5 is the external view of the image surface adjusting device 10, and drawing which looked at (a) from the -Y side, and (b) are drawings seen from the +Z side. As shown in drawing 5 , the image surface adjusting device 10 The 1st optical member 1 (1st optical member), It has the air bearing (non-contact equipment) 11 which supports the 2nd optical member (2nd optical member) 2, and the 1st optical member 1 and the 2nd optical member 2 in the non-contact condition, and the linear actuators (driving gear) 3, 5, and 6 which move the 1st optical member 1 to the 2nd optical member 2. Each of the 1st optical member 1 and the 2nd optical member 2 is formed in the shape of a wedge, is the glass plate which can penetrate exposure light, and constitutes the wedge mold optical member of a pair. Exposure light passes each of this 1st optical member 1 and the 2nd optical member 2.
[0052] The 1st optical member 1 has 1st injection side (1st inclined plane) 1b as an irradiation labor attendant which crosses aslant to 1st plane-of-incidence 1a and this 1st plane-of-incidence 1a as optical plane of incidence. moreover, the 2nd optical member 2 is formed so that 1st injection side 1b of the 1st optical member 1 may be countered -- having -- this 1st injection side 1b and abbreviation -- with 2nd plane-of-incidence (2nd inclined plane) 2a as parallel optical plane of incidence 1st plane-of-incidence 1a of the 1st optical member 1 -- receiving -- abbreviation -- it has 2nd injection side 2b as an parallel irradiation labor attendant.
[0053] The 1st optical member 1 and the 2nd optical member 2 are held by the air bearing (non-contact equipment) 11 at the non-contact condition in 1st injection side 1b and 2nd plane-of-incidence 2a which counter.
[0054] Drawing 6 is drawing showing the air bearing 11 as non-contact equipment, and is the top view of 1st injection side 1b of the 1st optical member 1. As shown in drawing 6 , the air bearing 11 is equipped with two or more positive pressure slot 1c formed in 1st injection side 1b of the 1st optical member 1, and 1d of two or more negative pressure slots. With this operation gestalt, as shown in drawing 6 , what has arranged 1d of negative pressure slots on both sides on both sides of positive pressure slot 1c, respectively is arranged two near the both ends of 1st injection side 1b.
[0055] As shown in drawing 5 , it connects with the non-illustrated positive pressure source of supply (compressed-gas feeder) V1 through passage, and when the positive pressure source of supply V1 drives, compressed gas (compressed air) is supplied to positive pressure slot 1c, and energizes each of positive pressure slot 1c in the direction which makes the 1st optical member 1 estrange to the 2nd optical member 2 (surfacing). On the other hand, it connects with the non-illustrated negative pressure source of supply (vacuum aspirator) V2 through passage, and when the negative pressure source of supply V2 drives, vacuum suction is carried out and the gas in 1d of negative pressure slots energizes 1d of negative pressure slots in the direction which the 1st optical member 1 is made to approach to the 2nd optical member 2 (contact).
[0056] By controlling suitably the positive pressure source of supply V1 and the negative pressure source of supply V2, and maintaining the repulsive force by positive pressure slot 1c, and the suction force by 1d of negative pressure slots to a predetermined value, 1st injection side 1b of the 1st optical member 1 and 2nd plane-of-incidence 2a of the 2nd optical member 2 counter, where the fixed gap G is maintained. Here, the magnitude of a gap G is set up based on optical aberration permissible [with Aligner EX]. That is, if a gap G becomes large too much, since optical aberration will occur, it is desirable to be set, for example as several micrometers - about 10 micrometers of numbers.
[0057] Here, the contact prevention film 9, such as chromium film, is formed in 2nd plane-of-incidence 2a of the 2nd optical member 2 in the shape of a rectangle, and the direct contact to 1st injection side 1b of the 1st optical member 1 and 2nd plane-of-incidence 2a of the 2nd optical member 2 is prevented in the condition that the air bearing 11 is not driving.
[0058] As shown in drawing 5 , the 1st optical member 1 is equipped with the linear actuator 3 linked to +X side edge side of this 1st optical member 1, and the linear actuator (driving gear) 5 and linear actuator (driving gear) 6 linked to +Y side edge side of the 1st optical member 1. It connected with +X side edge section among +Y side edge sides of the 1st optical member 1, and the linear actuator 5 has connected the linear actuator 6 to -X side edge section among +Y side edge sides of the 1st optical member 1.

[0059] Moreover, the guide section which is not illustrated [which supports this 1st optical member 1 possible / a slide / to the 2nd optical member 2] is connected to the 1st optical member 1. On the other hand, the 2nd optical member 2 is being fixed by the non-illustrated frame etc. In addition, of course, it is also possible to fix the 1st optical member 1, and to constitute the 2nd optical member 2 movable, or to constitute the both sides of the 1st and 2nd optical members 1 and 2 movable.
[0060] When a linear actuator 3 drives, the 1st optical member 1 moves to X shaft orientations so that 1st injection side 1b may be made to slide to 2nd plane-of-incidence 2a of the 2nd optical member 2.
[0061] Here, the amount of drives and drive rate (namely, movement magnitude and passing speed of the 1st optical member 1) of a linear actuator 3 are controlled by the control unit CONT. The location detection equipment 4 which consists of the potentiometer which can detect a location and linear encoder in X shaft orientations of the 1st optical member 1 is formed in -X side edge side of the 1st optical member 1, and location detection equipment 4 detects the location in the movement magnitude to a criteria location, i.e., X shaft orientations, of the 1st optical member 1 which moves. The detection result of location detection equipment 4 is outputted to a control unit CONT, and a control unit CONT asks for the location in X shaft orientations of the 1st optical member 1 based on the detection result of location detection equipment 4. And a control device CONT drives a linear actuator 3 based on said result searched for, and positions the 1st optical member 1 to a position in X shaft orientations. Moreover, based on the movement magnitude of the 1st optical member 1 per unit time amount, the passing speed of the 1st optical member 1 can also ask for a control unit CONT.
[0062] On the other hand, when either drives at least among a linear actuator 5 and a linear actuator 6, the 1st optical member 1 is rotated to the circumference of the Z-axis (circumference of an optical axis) so that 1st injection side 1b may be made to slide to 2nd plane-of-incidence 2a of the 2nd optical member 2. Here, if the amount of drives of linear actuators 5 and 6 (movement magnitude) is the same, the 1st optical member 1 will move to Y shaft orientations, and if the amounts of drives differ, the 1st optical member 1 will be rotated to the circumference of the Z-axis.
[0063] Each amount of drives and drive rate (namely, the rotation and rotational speed of the 1st optical member 1) of linear actuators 5 and 6 are controlled by the control unit CONT. The location detection equipments 7 and 8 which consist of the potentiometer which can detect a location and linear encoder in Y shaft orientations of the 1st optical member 1 are formed in -Y side edge side of the 1st optical member 1. It has connected with +X side edge section in -Y side edge side of the 1st optical member 1, and location detection equipment 7 has connected location detection equipment 8 to -X side edge section in -Y side edge side of the 1st optical member 1. Each of the location detection equipments 7 and 8 detects the location in the movement magnitude to a criteria location, i.e., Y shaft orientations, of the 1st optical member 1 which moves. The detection result of the location detection equipments 7 and 8 is outputted to a control unit CONT, and a control unit CONT is based on each detection result of two location detection equipments 7 and 8, and calculates the rotation (location about the circumference of the Z-axis) of the circumference of the Z-axis of the 1st optical member 1. And a control device CONT drives a linear actuator 5 or a linear actuator 6 based on said result searched for, to the circumference of the Z-axis, carries out specified quantity rotation and positions the 1st optical member 1. Moreover, based on the rotation of the 1st optical member 1 per unit time amount, the rotational speed of the 1st optical member 1 can also ask for a control unit CONT.
[0064] When drawing 7 slides the 1st optical member 1 to X shaft orientations to the 2nd optical member 2, it is drawing explaining signs that the image formation location of projection optics changes. As shown in drawing 7 , the relative dimension (thickness) of 1st plane-of-incidence 1a of the 1st optical member 1 and 2nd injection side 2b of the 2nd optical member 2 is changed by sliding to the location (sign 1 reference) shown as a continuous line from the location (refer to sign 1') which shows the 1st optical member with a broken line. Then, as for an image formation location, only distance delta is changed. That is, if the 1st optical member 1 moves to the -X side and the relative dimension of 1st plane-of-incidence 1a of the 1st optical member 1 and 2nd injection side 2b of the 2nd optical member 2 becomes large as shown in drawing 7 , an image formation location will be shifted to the -Z side. On the other hand, if a relative dimension becomes small, an image formation location will be shifted to the +Z side. therefore, the thing for which the 1st optical

member 1 is slid to X shaft orientations to the 2nd optical member 2 -- the image surface adjusting device 10 -- projection optics PL1-PL5 -- each image formation location can be adjusted.
[0065] Drawing 8 is a mimetic diagram for explaining the location of the image surface at the time of moving the 1st optical member 1 to the 2nd optical member 2 using each of linear actuators 3, 5, and 6. As shown in drawing 8 (a1), as shown in drawing 8 (a2), the location of the image surface of a pattern is moved in Z shaft orientations, i.e., the direction which intersects perpendicularly with the image surface, by carrying out slide migration to the 2nd optical member 2 at X shaft orientations to the location (sign 1 reference) which shows the 1st optical member 1 as a continuous line from the location (refer to sign 1') shown with a broken line. In the example shown in drawing 8 (a1), since the relative dimension of 1st plane-of-incidence 1a of the 1st optical member 1 and 2nd injection side 2b of the 2nd optical member 2 becomes small when the 1st optical member 1 moves to the +X side, the image surface is moved to the +Z side.
[0066] Here, the movement magnitude delta in Z shaft orientations of the image surface is based on the amount of drives of a linear actuator 3 (the amount of amendments). It can ask for the relation between the amount of drives of a linear actuator 3, and the movement magnitude delta in Z shaft orientations of the image surface beforehand, for example using experimental or numerical calculation. And said relation is memorized by the storage linked to a control unit CONT.
[0067] As shown in drawing 8 (b1), to the location (sign 1 reference) which shows the 1st optical member 1 as a continuous line from the location (refer to sign 1') shown with a broken line rotating to the circumference of the Z-axis to the 2nd optical member 2 -- that is The 1st and 2nd optical members 1 and 2 which are wedge mold optical members of a pair using the linear actuators 5 and 6 as a slewing gear (driving gear) by rotating relatively [circumference / of the optical axis of the optical path which penetrates this] As shown in drawing 8 (b2), the image surface of a pattern inclines to XY flat surface which becomes by the X-axis and the Y-axis (it rotates to the circumference of the X-axis). The 1st optical member 1 that is, by rotating to the 2nd optical member 2 As shown in drawing 8 (b1), the relative dimension of 1st plane-of-incidence 1a of the 1st optical member 1 and 2nd injection side 2b of the 2nd optical member 2 in -Y side edge section becomes small among the image surface adjusting devices 10. On the other hand, the relative dimension of 1st plane-of-incidence 1a of the 1st optical member 1 and 2nd injection side 2b of the 2nd optical member 2 in +Y side edge section becomes large. And since this relative dimension covers +Y side edge section and changes from -Y side edge section continuously, as shown in drawing 8 (b2), the image surface of a pattern inclines to XY flat surface.
[0068] Here, the rotation r to the Y-axis of the image surface is based on the amount of drives of linear actuators 5 and 6 (the amount of amendments). It can ask for the relation between the amount of drives of linear actuators 5 and 6, and the rotation r to the Y-axis of the image surface beforehand, for example using experimental or numerical calculation. And said relation is memorized by the storage linked to a control unit CONT.
[0069] In addition, in this operation gestalt, although constituted by two linear actuators 5 and 6, if the slewing gear which rotates the 1st optical member 1 to the 2nd optical member 2 is relatively pivotable in the 1st optical member 1 and the 2nd optical member 2, the equipment of arbitration can be used for it.
[0070] Next, it explains, referring to drawing 9 using the aligner EX which has the configuration mentioned above about the 1st operation gestalt of the approach of carrying out projection exposure of the pattern image of Mask M through projection optics PL1-PL5 at the sensitization substrate P. first, the image pick-up sensor 41 by which the control device CONT is formed in the substrate stage PST -- using -- the contrast of the projection fields 50a-50e -- detecting -- projection optics PL1-PL5 -- each image formation location and an image surface inclination are detected (step SA 1). A control device CONT is in the condition of not laying Mask M and the sensitization substrate P in a mask stage MST and the substrate stage PST, and, specifically, injects exposure light from the illumination-light study system IL. this, simultaneously the image pick-up sensor 41 move to X shaft orientations and Y shaft orientations, and the projection fields 50a-50e which projection optics PL1-PL5 was alike, respectively, and corresponded are scanned. The contrast in each projection fields 50a-50e is detected two-dimensional by the image pick-up sensor 41 to scan. The image pick-up sensor 41 outputs the detection result of the contrast of the projection fields 50a-50e to a control unit

CONT.
[0071] performing contrast detection, being in the condition which the projection fields 50a-50e boiled the control unit CONT, respectively, and has arranged the image pick-up sensor 41 here, and moving the substrate stage PST to Z shaft orientations -- projection optics PL1-PL5 -- each image formation location (location in Z shaft orientations of the image surface) is detected. Furthermore, a control unit CONT detects each image surface inclination of projection optics PL1-PL5 by detecting each contrast of the projection fields 50a-50e two-dimensional by the image pick-up sensor 41.
[0072] For example, in case the image formation location (location in Z shaft orientations of the image surface) of projection optics PL 1 is detected, a control device CONT arranges the image pick-up sensor 41 to projection field 50a, it performs contrast detection, moving to Z shaft orientations with the substrate stage PST, and makes the location in Z shaft orientations which detect the maximum contrast an image formation location. On the other hand, in case an image surface inclination is detected, based on measurement of the image formation location of two or more points of projection field 50a, it asks for a control unit CONT by the image pick-up sensor 41.
[0073] Subsequently, a control unit CONT amends the location of the image surface using the 1st optical member 1 and the 2nd optical member 2 (step SA 2). Namely, while a control unit CONT moves the 1st optical member 1 of the image surface adjusting device 10 to X shaft orientations to the 2nd optical member 2 The image pick-up sensor 41 performs contrast detection about each of projection optics PL1-PL5, rotating the 1st optical member 1 to the circumference of the Z-axis to the 2nd optical member 2. Based on this detection result, the location of the image surface is amended so that each image formation location of projection optics PL1-PL5 may turn into the same location by Z shaft orientations, and so that each of the projection fields 50a-50e may have a predetermined trapezoid configuration. thereby -- projection optics PL1-PL5 -- the location in the Z direction of each image surface -- the same -- becoming -- and the projection optics PL1-PL5 -- each optical axis and image surface intersect perpendicularly.
[0074] And a control unit CONT sets up the location (posture) about the circumference of X shaft orientations of the 1st optical member 1 of the projection optics PL 1 at this time - PL5 ********, and the 2nd optical member 2, and the Z-axis as an initial valve position, and memorizes it to storage. in this way, the projection optics PL1-PL5 -- the location in Z shaft orientations of each image surface -- mutual -- etc. -- it spreads -- it becomes -- as -- and the projection optics PL1-PL5 -- a calibration is performed so that each image surface and optical axis may intersect perpendicularly. in addition -- as the initial valve position of the 1st optical member 1 and the 2nd optical member 2 -- projection optics PL1-PL5 -- it is not necessary to be the location which makes in agreement the location about the circumference of Z shaft orientations of each image surface, and the X-axis if it puts in another way -- a calibration -- projection optics PL1-PL5 -- the location in Z shaft orientations of each image surface -- mutual -- etc. -- it spreads -- so that it may become It is not necessary to carry out so that each image surface and optical axis may intersect perpendicularly. and the projection optics PL1-PL5 -- the shape of for example, surface type of the sensitization substrate P -- responding -- projection optics PL1-PL5 -- changing mutually the location in Z shaft orientations of each image surface, and setting it up **** -- projection optics PL1-PL5 -- a calibration which inclines and sets up each image surface and optical axis may be performed.
[0075] Subsequently, Mask M is loaded to a mask stage MST (step SA 3). In addition, the sensitization substrate P is not loaded to the substrate stage PST at this time.
[0076] If Mask M is loaded, a control unit CONT will detect the amount of bending of Mask M (step SA 4). Specifically, a control unit CONT carries out the synchronized drive of the mask stage MST which supports Mask M, and the substrate stage PST equipped with the image pick-up sensor 41 to X shaft orientations to projection optics PL1-PL5, illuminating Mask M with exposure light by the illumination-light study system IL. A control unit CONT detects the contrast of the pattern of the projection fields 50a-50e based on the exposure light through two or more locations in the scanning direction of Mask M by detecting the exposure light through the mask M to scan by the image pick-up sensor 41. The detection result of the image pick-up sensor 41 is outputted to a control unit CONT. the projection fields 50a-50e which detected the control unit CONT by the image pick-up sensor 41 -- the amount of bending of Mask M is calculated based on the contrast of each pattern. namely, the projection fields 50a-50e based on the exposure light which minded Mask M when the

mask M currently supported by the mask stage MST had bent -- since image formation of each pattern is not carried out -- the image pick-up sensor 41 -- the projection fields 50a-50e -- the location of the image surface which the projection fields 50a-50e are alike, respectively, and corresponds is detectable by detecting the good location of the contrast of each pattern. Here, with the location of the image surface, the location in Z shaft orientations and the location in the inclination direction over a Y-axis are included.
[0077] The relation between the amount of bending of Mask M and the image surface location of the projection optics in that case is beforehand memorized by the control unit CONT (or storage linked to a control unit CONT), and a control unit CONT can calculate an image surface location to it based on this relation from the amount of bending of the mask M in two or more locations of a scanning direction. Moreover, what is necessary is to bend and for the image surface adjusting device 10 to be adjusted corresponding to the amount, and just to amend the difference with an image surface adjusting device about the amount of bending of Mask M, when the mask which was memorized beforehand and with which the amounts of bending differ is used since it is rare to change a lot even if Mask M changes. Moreover, in case an image surface location is adjusted using the mask used as criteria, it is made for the activation point of the image surface adjusting device 10 to turn into a neutral location, and it adjusts an image surface location by adjusting some optical members of the optical system attached to others, or projection optics. The drive margin of the image surface adjusting device 10 is securable as a result. Moreover, initial setting can also be performed in a short time. In addition, by using the focal sensor 20 by the side of a mask, the amount of bending of a mask can be measured during exposure, it can ask for an image surface location at any time based on the amount of bending of a mask also during exposure, and it is possible for this to amend with the image surface adjusting device 10. Moreover, together with the control of an image surface location based on bending of a mask, the exposure side of the sensitization substrate P is measured by the focal sensor 20, and if the image surface adjusting device 10 is controlled so that an image surface location and the exposure side of the sensitization substrate P are mostly in agreement, precision can improve the pattern of Mask M image formation to the sensitization substrate P. And based on the amount of bending of the mask M in two or more locations of a scanning direction, a control unit CONT computes the approximation curved surface of the front face of Mask M (step SA 5).
[0078] Subsequently, the sensitization substrate P is loaded to the substrate stage PST (step SA 6).
[0079] If the sensitization substrate P is loaded to the substrate stage PST, a control unit CONT will perform the preliminary scan before performing exposure processing. That is, a control unit CONT is in the condition of not performing lighting by the illumination-light study system IL, for example, is in the condition which intercepted the illumination light of the illumination-light study system IL with the non-illustrated shutter, and carries out the synchronized drive of the mask stage MST which supports Mask M, and the substrate stage PST which supports the sensitization substrate P to X shaft orientations to projection optics PL1-PL5. During this preliminary scan, the alignment systems 49a and 49b perform alignment of Mask M and the sensitization substrate P.
[0080] First, a control unit CONT performs relative location (posture) detection in X shaft orientations and Y shaft orientations of Mask M and the sensitization substrate P using the alignment systems 49a and 49b (step SA 7).
[0081] When it specifically advances between the illumination-light study systems IL and Masks M whose alignment systems 49a and 49b are predetermined detection locations and the substrate alignment marks 52c and 52b of the sensitization substrate P come to the location of the projection fields 50a and 50e The relative location gap with the substrate alignment marks 52c and 52b and the mask alignment mark currently formed in the mask M corresponding to these is detected by the alignment systems 49a and 49b. Subsequently When the substrate alignment marks 52d and 52a of the sensitization substrate P come to the location of the projection fields 50a and 50e, by the alignment systems 49a and 49b The relative location gap with the substrate alignment marks 52d and 52a and the mask alignment mark currently formed in the mask M corresponding to these is detected.
[0082] Based on the detection result of the alignment systems 49a and 49b, a control unit CONT drives a mask stage MST and the substrate stage PST through the mask stage mechanical component MSTD and the substrate stage mechanical component PSTD, and carries out alignment of Mask M

and the sensitization substrate P (step SA 8).
[0083] On the other hand, in parallel to processing of the above-mentioned step SA 7, the focal sensor 20 performs relative-distance detection in Z shaft orientations of the front face of the sensitization substrate P (step SA 9). A control unit CONT uses the focal sensor 20 during a preliminary scan, and performs detection of the relative distance in Z shaft orientations of the front face of the sensitization substrate P, i.e., the location detection in Z shaft orientations of the front face of the sensitization substrate P. Specifically based on the focal signal about the sensitization substrate P by each of two or more focal sensors 20, a control unit CONT is memorized to storage by using as surface data the relative distance in Z shaft orientations of the sensitization substrate P corresponding to the predetermined X coordinate and predetermined Y coordinate which were specified in a grid pattern by sampling the location in Z shaft orientations of the sensitization substrate P in a predetermined pitch, scanning Mask M and the sensitization substrate P. The sampling position in X shaft orientations of this surface data is a location shown by the cross line and the cross-joint dotted line in drawing 4 . In addition, although surface data precision improves so that the number of samplings in X shaft orientations of the sensitization substrate P is made [many], in consideration of relation with the time amount which signal processing and data processing take, it is set up suitably. In addition, since it is measurable on real time if a sensor in a grid pattern is used, it is measurable in Rhine.
[0084] A control unit CONT computes the approximation curved surface of the shape of surface type of the sensitization substrate P using the approximation approaches, such as a least square method, based on the surface data as a set of the relative distance of Z shaft orientations in the discrete location in XY flat surface memorized by storage (step SA 10). That is, a control unit CONT asks for the flatness of the sensitization substrate P based on the detection result in two or more locations of the sensitization substrate P by the focal sensor 20.
[0085] Next, based on the information about the shape of surface type of the mask M for which it asked at a step SA 5, and the information about the shape of surface type of the sensitization substrate P for which it asked at a step SA 10, a control unit CONT finds the relative distance in Z shaft orientations of Mask M and the sensitization substrate P, and makes this surface data (step SA 11). A control device CONT searches for the focal error about each of two or more projection optics PL1-PL5, and the position error (image surface position error) of the image surface and a sensitization substrate front face based on said result (surface data) searched for.
[0086] Next, a control device CONT computes a leveling controlled variable (step SA 12). the projection optics PL1-PL5 which specifically set up the control unit CONT at a step SA 2 -- with each image formation location (focal distance) As [serve as / / Y shaft orientations / a focal error (distance in Z shaft orientations of the image formation location of projection optics PL1-PL5 and surface data) / based on the surface data for which it asked at a step SA 11 / min] The rotation of the circumference of the X-axis of the substrate stage PST and the shift amount in Z shaft orientations are computed, and let this be a leveling controlled variable to the substrate stage mechanical component PSTD which adjusts the posture of the substrate stage PST. Moreover, in carrying out amendment control also about rotation of Y-axis ****** of the substrate stage PST, the rotation of the circumference of this Y-axis is computed similarly, and it considers as the leveling controlled variable to the substrate stage mechanical component PSTD also including this. This leveling controlled variable is computed for every predetermined feed per revolution according to the feed per revolution (movement magnitude) to X shaft orientations of the substrate stage PST.
[0087] Next, a control device CONT amends the surface data computed at a step SA 11 based on the leveling controlled variable computed at a step SA 12, and asks for new surface data (step SA 13).
[0088] the projection optics PL1-PL5 which set up the control unit CONT at a step SA 2 -- the focal error which remains based on each image formation location and the new surface data for which it asked at a step SA 13 -- asking -- this result searched for -- being based -- projection optics PL1-PL5 -- the amount of amendments of each image formation location is calculated (step SA 14). specifically, a control unit CONT reduces the focal error which remains -- as -- projection optics PL1-PL5 -- the amount of amendments (refer to drawing 8 sign delta) which amends each image-formation location is calculated, and it asks for the location of drives in X shaft orientations over the 2nd optical member 2 of the 1st optical member 1 of the image surface adjusting device 10, i.e., the

amount of a linear actuator 3, (the amount of amendments) based on this result searched for. Here, a control device CONT sets up the location of drives about X shaft orientations of the 2nd optical member 2 to the 1st optical member 1 amended to compensate for a synchronized drive, i.e., the amount of a linear actuator 3, so that each of the sensitization substrate P front face which carries out a synchronized drive, for example, two or more locations set up in a grid pattern, and the image formation location of projection optics PL1-PL5 may be in agreement according to the surface data which have irregularity that is,.

[0089] furthermore, the projection optics PL1-PL5 which set up the control unit CONT at a step SA 2 -- each image surface inclination and the new surface data for which it asked at a step SA 13 -- being based -- the position error of the image surface and surface data (sensitization substrate P front face) -- asking -- this result searched for -- being based -- projection optics PL1-PL5 -- the amount of amendments of each image surface inclination is calculated (step SA 15). the surface data with which a control device CONT specifically has irregularity, and projection optics PL1-PL5 -- so that each image surface may be made in agreement The amount of amendments (refer to drawing 8 sign r) which amends each image surface inclination is calculated. projection optics PL1-PL5 -- It asks for the location of drives about the circumference of the Z-axis to the 2nd optical member 2 of the 1st optical member 1 of the image surface adjusting device 10, i.e., the amount of linear actuators 5 and 6, (the amount of amendments) based on this result searched for. Here, a control device CONT sets up the location of drives about the circumference of the Z-axis of the 2nd optical member 2 to the 1st optical member 1 amended to compensate for a synchronized drive, i.e., the amount of linear actuators 5 and 6, so that each of the sensitization substrate P front face which carries out a synchronized drive, for example, two or more locations set up in a grid pattern, and the image surface of projection optics PL1-PL5 may be in agreement according to the surface data which have irregularity that is,.

[0090] A control unit CONT sets up the amount of the amount 3 of amendments in the image surface adjusting device 10 amended to compensate for the synchronized drive of Mask M and the sensitization substrate P, i.e., a linear actuator, and linear actuators 5 and 6 of amendments according to the location set up, for example in the shape of [said] the squares based on the amount of amendments calculated at a step SA 14 and a step SA 15, and memorizes it to storage by using this set-up amount of amendments as a control map (a step SA 16).

[0091] Furthermore, according to the synchronous passing speed set up at the above-mentioned step SA 2 etc., a control unit CONT sets up the amendment rate of the image surface, i.e., the movement magnitude per unit time amount in Z shaft orientations of the image surface, and the rotation per [to the Y-axis of the image surface] unit time amount (the amount of inclinations) so that the image surface and surface data (sensitization substrate P front face) may be in agreement to compensate for the synchronized drive of Mask M and the sensitization substrate P. Based on the amendment rate of the set-up image surface, a control device CONT sets up the drive rate of a linear actuator 3 and linear actuators 5 and 6, and also memorizes this set-up drive rate (amendment rate) to storage as a control map.

[0092] When memorizing to storage beforehand by using as a control map the amount of amendments in the image surface adjusting device 10 amended to compensate for the synchronized drive of Mask M and the sensitization substrate P, a control unit CONT While canceling cutoff of the illumination light by the shutter of the illumination-light study system IL The scan exposure which imprints the pattern image of Mask M to the sensitization substrate P through projection optics PL1-PL5 is started, carrying out the synchronized drive of the mask stage MST which supports Mask M, and the substrate stage PST which supports the sensitization substrate P (step SA 17).

[0093] It faces performing scan exposure, and first, a control unit CONT adjusts an image surface inclination while adjusting the location in Z shaft orientations of the image surface of a pattern based on said control map memorized to storage (step SA 18).

[0094] And scan exposure is performed, changing the amount of amendments in the image surface adjusting device 10 in connection with this synchronized drive based on the control map currently called for beforehand, while a control unit CONT carries out the synchronized drive of Mask M and the sensitization substrate P (step SA 19).

[0095] driving the image surface adjusting device 10 based on said control map, while a control

device CONT drives the substrate stage mechanical component PSTD suitably based on the leveling controlled variable in the direction of a synchronized drive and performing leveling control -- each projection optics PL1-PL5 -- exposure processing is performed to the sensitization substrate P, making each image surface in agreement with the front face of the sensitization substrate P (step SA 20).
[0096] According to the aligner EX of this operation gestalt, as shown in drawing 10 (a), Mask M bends in Y shaft orientations (non-scanning direction). projection optics PL1-PL5, even when each image surface and a sensitization substrate P front face are not in agreement According to the shape of surface type of Mask M and the sensitization substrate P, the 1st optical member 1 of the image surface adjusting device 10 by moving to X shaft orientations to the 2nd optical member 2 it is shown in drawing 10 (b) -- as -- projection optics PL1-PL5 -- the location in Z shaft orientations of each image surface and the front face of the sensitization substrate P can be doubled. and -- since the image surface inclines as by rotating to the circumference of the Z-axis to the 2nd optical member 2 shows the 1st optical member 1 to drawing 10 (c), even if it is the irregular sensitization substrate P -- this sensitization substrate P and projection optics PL1-PL5 -- each image surface -- about -- it can be made to do one In addition, what is necessary is being able to measure a surface inclination correctly and making it just make the image surface incline to it, if three or more focal sensors which measure the front face of Mask M and the sensitization substrate P are formed in a projection field.
[0097] Moreover, as shown in drawing 11 (a), Mask M or the sensitization substrate P bends in X shaft orientations (scanning direction). projection optics PL1-PL5, even when each image surface and a sensitization substrate P front face are not in agreement According to the shape of surface type of the sensitization substrate P, the 1st optical member 1 of the image surface adjusting device 10 in connection with a synchronized drive by moving to X shaft orientations to the 2nd optical member 2 it is shown in drawing 11 (b) -- as -- projection optics PL1-PL5 -- the location in Z shaft orientations of each image surface and the front face of the sensitization substrate P can be doubled. In addition, since the thing width of face in X shaft orientations of the projection fields 50a-50e is narrow, the image surface inclination to the X-axis has composition which is not performed, is justification in Z shaft orientations of the image surface, and can make a sensitization substrate P front face and the image surface in agreement with this operation gestalt about a scanning direction.
[0098] And the focal error in each location of the front face of the sensitization substrate P can be made small on the average by carrying out leveling control based on a leveling controlled variable, rotating the substrate stage PST during scan exposure at the circumference of the X-axis, as shown in drawing 12 (a). and -- in addition, as the focal error which remains in addition also by this leveling control was mentioned above, while the image surface adjusting device 10 adjusts the location of the image surface to Z shaft orientations, the position error of the image surface and a sensitization substrate P front face can be made small according to an individual by the own image surface justification of projection optics by adjusting the image surface inclination of a pattern image. Thus, a control device CONT can perform scan exposure, adjusting the inclination (leveling) in Y shaft orientations of the substrate stage PST through the substrate stage mechanical component PSTD. It is also possible to carry out leveling adjustment, rotating the substrate stage PST to the circumference of a Y-axis similarly, as shown in drawing 12 (b), and the focal error in each location of the front face of the sensitization substrate P can be made small on the average also in this case. That is, a control device CONT can perform scan exposure, adjusting the inclination in X shaft orientations of the substrate stage PST through the substrate stage PSTD. Here, in drawing 12 , the sensitization substrate P which the sensitization substrate P shown with a broken line shows the condition that leveling control is performed, and is shown as a continuous line shows the condition that leveling control is performed. In addition, since the thing width of face in X shaft orientations of the projection fields 50a-50e is narrow, even if it does not perform scan exposure, adjusting the inclination in X shaft orientations, it is only justification about Z shaft orientations of the substrate stage PST, and can make a sensitization substrate P front face and the image surface in agreement with this operation gestalt about a scanning direction. Moreover, it is desirable to perform leveling adjustment of the sensitization substrate P so that it may become the image surface adjustable range of the image surface adjusting device 10 with which each projection optics was equipped, and to make it both interlock.

[0099] Since it had the image surface adjusting device 10 which adjusts the image surface inclination of a pattern image while adjusting the location of the image surface of a pattern to Z shaft orientations as explained above, the image surface adjusting device 10 can reduce a focal error by adjusting the location of the image surface of a pattern. Moreover, even if irregularity exists in the front face of the sensitization substrate P and Mask M by adjusting the image surface inclination of a pattern image, the image surface of a pattern and the front face of the sensitization substrate P can be made in agreement. Therefore, even when performing exposure processing, carrying out the synchronous scan of Mask M and the sensitization substrate P, scan exposure can be performed, reducing the position error of the image surface and the front face of the sensitization substrate P.
[0100] The image surface adjusting device 10 has the wedge mold optical member of a pair which consists of the 1st optical member 1 which has 1st injection side 1b, and the 2nd optical member 2 which has 2nd plane-of-incidence 2a which counters 1st injection side 1b, only rotates these relatively [circumference / of the Z-axis], and can make the image surface of a pattern incline simply to the Z-axis. Therefore, since what is necessary is just to make the image surface incline according to this irregularity even if irregularity exists in the sensitization substrate P, accurate scan exposure can be performed, reducing the position error of the front face of the sensitization substrate P, and the image surface.
[0101] Since the amount of bending in the scanning direction of Mask M is beforehand calculated using the image pick-up sensor 41 and the image surface adjusting device 10 is controlled based on this calculated amount of bending, even if it originates in bending of Mask M and the location of the image surface changes, the image surface and a position error with the sensitization substrate P can be reduced.
[0102] In addition, although it indicates that the image pick-up sensor 41 measures an illuminance and contrast, you may make it form separately the sensor of the dedication which measures an illuminance. Moreover, it may be made to measure the base line by the image pick-up sensor 41, and the image through projection optics may be made to perform location measurement of a mask, and location measurement of the pattern of a mask.
[0103] since the 1st optical member 1 and the 2nd optical member 2 are held so that it may counter at fixed spacing in the state of non-contact by the air bearing 11 -- projection optics PL1-PL5 -- while being able to tune each image surface location finely with high degree of accuracy, since it is non-contact, there is also little degradation with time and accurate adjustment can be performed over a long period of time.
[0104] in addition, as non-contact equipment which holds the 1st optical member 1 and the 2nd optical member 2 in the non-contact condition It may be what combined the suction force by magnetism, and the repulsive force by positive pressure besides the air bearing by the combination of the suction force by negative pressure as shown with the above-mentioned operation gestalt, and the repulsive force by positive pressure, and what combined the suction force by negative pressure and the repulsive force by magnetism may be used. Moreover, what combined the suction force by magnetism and the repulsive force by magnetism may be used, and what combined suitably gravity, the energization force with a spring, etc. the above-mentioned positive pressure or negative pressure, magnetism, etc. may be used further.
[0105] In the above-mentioned operation gestalt, although the 1st optical member 1 and the 2nd optical member 2 are in the non-contact condition by the air bearing 11, they do not necessarily need to be in a non-contact condition. You may make it rotate the wedge mold optical member of a pair relatively by the linear actuators 5 and 6 as a slewing gear which makes the wedge mold optical member of a pair a contact condition, and makes each pivotable relatively at the circumference of the optical axis of the optical path which penetrates the wedge mold optical member of this pair. On the other hand, degradation of an optical member can be suppressed by rotating the wedge mold optical member of a pair relatively in the state of non-contact.
[0106] In the above-mentioned operation gestalt, although it explained that leveling control and image surface adjustment were performed based on Mask M and the surface data about the relative distance in Z shaft orientations of the sensitization substrate P, only by being based on the surface data about Mask M, or only by being based on the surface data about the sensitization substrate P, it can carry out.

[0107] In addition, making pivotable the mask stage MST which supports Mask M at the circumference of the X-axis, and the circumference of a Y-axis, and carrying out leveling control of the mask stage MST using the mask stage mechanical component MSTD, although it explained that it faced performing scan exposure in the above-mentioned operation gestalt, and leveling control was performed about the substrate stage PST which supports the sensitization substrate P, may be and you may carry out so that scan exposure may be carried out.
[0108] After searching for the approximation curved surface of Mask M by the image pick-up sensor 41 with the above-mentioned operation gestalt, Although it is the configuration which searches for the approximation curved surface of the sensitization substrate P by the focal sensor 20, computes the surface data about the relative distance of Mask M and the sensitization substrate P based on these approximation curved surfaces, and controls the image surface adjusting device 10 according to the computed surface data The amount of bending of Mask M and the sensitization substrate P The magnitude of these masks M and the sensitization substrate P, It asks theoretically using numerical calculation etc. and you may make it control the image surface adjusting device 10 based on the amount of bending of this mask M for which it asked and sensitization substrate P based on the support location of a configuration and the quality of the material, and a stage etc.
[0109] In the above-mentioned operation gestalt, it is the configuration that the shape of surface type of Mask M is searched for based on the detection result of the image pick-up sensor 41, the shape of surface type of the sensitization substrate P is searched for based on the detection result of the focal sensor 20, and surface data are computed based on the shape of these surface type called for separately from the relative distance in Z shaft orientations of Mask M and the sensitization substrate P. On the other hand, the focal sensor 20 may be made to perform relative-distance detection in Z shaft orientations of the front face of Mask M, and the front face of the sensitization substrate P. A control unit CONT uses the focal sensor 20 during a preliminary scan, and performs location detection in Z shaft orientations of each front face of the detection M of the relative distance in Z shaft orientations of each front face of Mask M and the sensitization substrate P, i.e., a mask, and the sensitization substrate P. It is specifically based on the focal signal about the mask M by each of two or more focal sensors 20, and the sensitization substrate P, scanning Mask M and the sensitization substrate P. By sampling the location in Z shaft orientations of Mask M and the sensitization substrate P in a predetermined pitch, a control unit CONT It memorizes to storage by using as surface data the relative distance in Z shaft orientations of the mask M corresponding to the predetermined X coordinate and predetermined Y coordinate which were specified in a grid pattern, and the sensitization substrate P. and Mask M and the sensitization substrate P -- let this be surface data in quest of the relative distance in Z shaft orientations of Mask M and the sensitization substrate P based on the location in Z shaft orientations about each.
[0110] Although the above-mentioned operation gestalt explained that leveling control and the image surface justification by the image surface adjusting device 10 were used together, of course, only image surface adjusting-device 10 can reduce the image surface and a position error with the sensitization substrate P (surface data). However, since movement magnitude of the 1st optical member 1 (or the 2nd optical member 2) of the image surface adjusting device 10 must be enlarged when the image surface and a position error with the sensitization substrate P are large, the problem of interfering with the member in an aligner may occur. In this case, the movement magnitude of the 1st optical member 1 (or the 2nd optical member 2) of the image surface adjusting device 10 can be stopped by using leveling control together.
[0111] With the above-mentioned operation gestalt, each of the 1st optical member 1 and the 2nd optical member 2 is a configuration from which thickness changes gradually toward X shaft orientations, and 1st injection side 1b and 2nd plane-of-incidence 2a which are the inclined plane of the 1st optical member 1 and the 2nd optical member 2 incline in X shaft orientations. Thereby, by rotating relatively [circumference / of the Z-axis] the 1st optical member 1 and the 2nd optical member 2, as explained using drawing 8 , the image surface inclines to a Y-axis. On the other hand, each of the 1st optical member 1 and the 2nd optical member 2 is made into the configuration from which thickness changes gradually toward Y shaft orientations. Namely, 1st injection side 1b and 2nd plane-of-incidence 2a which are the inclined plane of the 1st optical member 1 and the 2nd optical member 2 are set up so that it may incline in Y shaft orientations. The image surface can be

made to incline to the X-axis by rotating relatively [circumference / of the Z-axis] the 1st optical member 1 and the 2nd optical member 2 which have this configuration. Even if it is the case where the width of face in X shaft orientations of the projection fields 50a-50e became large, Mask M bent in X shaft orientations by this, and image surface slope regulation needs to be performed also in a scanning direction, scan exposure can be performed making in agreement the sensitization substrate P (surface data) and the image surface. In addition, since each of the projection fields 50a-50e is a configuration long to Y shaft orientations (non-scanning direction) and it is narrow to X shaft orientations in this operation gestalt, Even if it does not perform image surface slope regulation according to the irregularity of the front face of the sensitization substrate P about X shaft orientations, image surface justification in Z shaft orientations is only performed, and abbreviation coincidence of the front face of the sensitization substrate P and the image surface in X shaft orientations can be carried out.

[0112] Moreover, the both sides of the image surface adjusting device equipped with the 1st and 2nd optical member which has the inclined plane which inclines in X shaft orientations, respectively, and the image surface adjusting device equipped with the 1st and 2nd optical member which has the inclined plane which inclines in Y shaft orientations, respectively are prepared on the optical path of exposure light, and it can also consider as the configuration which performs exposure processing, making the image surface incline to each of a Y-axis and the X-axis with these two image surface adjusting devices.

[0113] Next, the 2nd operation gestalt of the exposure approach is explained, referring to drawing 13 . here, simple [about a component the same as that of the above-mentioned 1st operation gestalt, or equivalent / in the explanation] in the following explanation -- or it omits. Mask M is loaded to a mask stage MST (step SB 1).

[0114] Next, a control unit CONT illuminates Mask M with exposure light by the illumination-light study system IL, and the image pick-up sensor 41 in which it is prepared on the substrate stage PST detects the illuminance of the projection fields 50a-50e based on the exposure light through this mask M (step SB 2). The image pick-up sensor 41 outputs the detection result of the illuminance of the projection fields 50a-50e to a control unit CONT. By detecting each illuminance of the projection fields 50a-50e two-dimensional by the image pick-up sensor 41, a control unit CONT detects the contrast of each image of projection optics PL1-PL5, and asks for the location (the location in Z shaft orientations, and location of the inclination direction over a Y-axis) of the image surface.

[0115] Subsequently, a control unit CONT amends the location of the image surface using the 1st optical member 1 and the 2nd optical member 2 (step SB 3). Namely, while a control unit CONT moves the 1st optical member 1 of the image surface adjusting device 10 to X shaft orientations to the 2nd optical member 2 The image pick-up sensor 41 performs illuminance detection about each of projection optics PL1-PL5, rotating the 1st optical member 1 to the circumference of the Z-axis to the 2nd optical member 2. Based on this detection result, the location of the image surface is amended so that each image formation location of projection optics PL1-PL5 may turn into the same location by Z shaft orientations, and so that each of the projection fields 50a-50e may have a predetermined trapezoid configuration. thereby -- projection optics PL1-PL5 -- the location in the Z direction of each image surface -- the same -- becoming -- and the projection optics PL1-PL5 -- each optical axis and image surface intersect perpendicularly.

[0116] And a control unit CONT memorizes the amount of amendments about the circumference of X shaft orientations of the 1st optical member 1 of the projection optics PL 1 at this time - PL5 ********, and the 2nd optical member 2, and the Z-axis (the amount of drives of linear actuators 3, 5, and 6) to storage. in this way, the projection optics PL1-PL5 -- the location in Z shaft orientations of each image surface -- mutual -- etc. -- it spreads -- it becomes -- as -- and the projection optics PL1-PL5 -- a calibration is performed so that each image surface and optical axis may intersect perpendicularly, and the amount of amendments of the image surface adjusting device 10 accompanying the synchronized drive at this time is set up and memorized.

[0117] That is, with the 1st operation gestalt, although it is the configuration that the image surface adjusting device 10 performs image surface justification (calibration) by the projection optics independent as a step SA 2 explained, in the 2nd operation gestalt, image surface justification is performed using the light through Mask M. That is, with the 2nd operation gestalt, the calibration

amended also including the image surface location change resulting from the amount of bending of Mask M is performed.
[0118] Subsequently, the sensitization substrate P is loaded to the substrate stage PST (step SB 4).
[0119] If the sensitization substrate P is loaded to the substrate stage PST, a control unit CONT will perform the preliminary scan before performing exposure processing. That is, a control unit CONT is in the condition of not performing lighting by the illumination-light study system IL, and carries out the synchronized drive of the mask stage MST which supports Mask M, and the substrate stage PST which supports the sensitization substrate P to X shaft orientations to projection optics PL1-PL5. During this preliminary scan, the alignment systems 49a and 49b perform alignment of Mask M and the sensitization substrate P.
[0120] A control unit CONT performs relative location (posture) detection in X shaft orientations and Y shaft orientations of Mask M and the sensitization substrate P using the alignment systems 49a and 49b (step SB 5).
[0121] Based on the detection result of the alignment systems 49a and 49b, a control unit CONT drives a mask stage MST and the substrate stage PST through the mask stage mechanical component MSTD and the substrate stage mechanical component PSTD, and carries out alignment of Mask M and the sensitization substrate P (step SB 6).
[0122] On the other hand, in parallel to processing of the above-mentioned step SB 5, the focal sensor 20 performs relative-distance detection in Z shaft orientations of the front face of the sensitization substrate P (step SB 7). A control unit CONT uses the focal sensor 20 during a preliminary scan, and performs detection of the relative distance in Z shaft orientations of the front face of the sensitization substrate P, i.e., the location detection in Z shaft orientations of the front face of the sensitization substrate P.
[0123] Based on the data about the location in Z shaft orientations of the sensitization substrate P for which it asked at a step SB 7, a control unit CONT computes the approximation curved surface of the shape of surface type of the sensitization substrate P using the approximation approaches, such as a least square method, and uses it as surface data (step SB 8).
[0124] A control device CONT searches for the focal error about each of two or more projection optics PL1-PL5, and the position error (image surface position error) of the image surface and a sensitization substrate P front face based on said surface data.
[0125] Next, a control device CONT computes a leveling controlled variable (step SB 9).
[0126] A control device CONT amends the surface data computed at a step SB 8 based on the leveling controlled variable computed at a step SB 9, and asks for new surface data (step SB 10).
[0127] the projection optics PL1-PL5 which set up the control unit CONT at a step SB 3 -- the focal error which remains based on each image formation location and the new surface data for which it asked at a step SB 10 -- asking -- this result searched for -- being based -- projection optics PL1-PL5 -- the amount of amendments of each image formation location is calculated (step SB 11).
[0128] furthermore, the projection optics PL1-PL5 which set up the control unit CONT at a step SB 3 -- each image surface inclination and the new surface data for which it asked at a step SB 10 -- being based -- the position error of the image surface and surface data (sensitization substrate P front face) -- asking -- this result searched for -- being based -- projection optics PL1-PL5 -- the amount of amendments of each image surface inclination is calculated (step SB 12).
[0129] That is, the amount of amendments for making the image surface in agreement with the amount of amendments for amending the image surface location change resulting from bending of Mask M for which it asked at a step SB 3 to the shape of surface type of the sensitization substrate P is added.
[0130] A control unit CONT sets up the amount of the amount 3 of amendments in the image surface adjusting device 10 amended to compensate for the synchronized drive of Mask M and the sensitization substrate P, i.e., a linear actuator, and linear actuators 5 and 6 of amendments according to the location set up, for example in the shape of [said] the squares based on the amount of amendments calculated at a step SB 11 and a step SB 12, and memorizes it to storage by using this set-up amount of amendments as a control map (a step SB 13).
[0131] When memorizing to storage beforehand by using as a control map the amount of amendments in the image surface adjusting device 10 amended to compensate for the synchronized

drive of Mask M and the sensitization substrate P, a control unit CONT While canceling cutoff of the illumination light by the shutter of the illumination-light study system IL Scan exposure which imprints the pattern image of Mask M to the sensitization substrate P through projection optics PL1-PL5 is performed, carrying out the synchronized drive of the mask stage MST which supports Mask M, and the substrate stage PST which supports the sensitization substrate P (step SB 14).

[0132] The image pick-up sensor 41 detects the exposure light through each. it explained above -- as -- Mask M and two or more projection optics PL1-PL5 -- By performing image surface justification based on this detection result, and calculating beforehand the amount of amendments for amending the image surface location change resulting from bending of Mask M For example, since what is necessary is just to perform derivation of the amount of amendments for amending the image surface location change resulting from bending of Mask M once when performing exposure processing, carrying out sequential exchange of the sensitization substrate P without exchanging Mask M, a man day can be reduced and working efficiency can be improved. And scan exposure can carry out by asking for the surface-type-like data of the sensitization substrate P using the focal sensor 20, calculating the amount of amendments for making in agreement the front face and the image surface of this sensitization substrate P, and performing image surface justification in the amount of amendments which doubled the amount of amendments to this sensitization substrate for which it asked, and the amount of amendments to a mask, making the image surface and a sensitization substrate P in agreement with a sufficient precision.

[0133] In addition, with the above-mentioned 2nd operation gestalt, the focal sensor 20 detects the location in Z shaft orientations of the sensitization substrate P. Although it explained that it asked for the surface data (approximation curved surface) of the sensitization substrate P from this detection result, a control map was created based on this result searched for, and the image surface adjusting device 10 performed image surface justification based on this control map Scan exposure is performed the read-ahead sensor in which the shape of surface type of the sensitization substrate P was prepared from projection optics at the direction front side of a synchronized drive detecting without creating a control map, and it may be made to perform control and leveling control of the image surface adjusting device 10 based on the detection result of a read-ahead sensor. That is, it may be made to perform image surface adjustment, a read-ahead sensor detecting the shape of surface type of the sensitization substrate P, without creating a control map.

[0134] In each above-mentioned operation gestalt, the pattern image on the sensitization substrate P may move to for example, X shaft orientations by carrying out image surface justification with the image surface adjusting device 10. In this case, scan exposure is carried out, performing amendment about the relative characteristic of image (a shift, rotation, scaling) of Mask M and the sensitization substrate P. For example, in the step SA 7 in the 1st operation gestalt etc., the alignment systems 49a and 49b detect a mark location with the procedure as the above-mentioned mask alignment mark and substrate alignment marks [52a-52d] detection procedure in which a control unit CONT is the same, making non-illustrated the mask mark and substrate mark for characteristic-of-image amendment repeat mutually one by one. A control unit CONT asks for the location of all the patterns that used the alignment systems 49a and 49b, detected the positional information of a mask mark and a substrate mark in order to carry out alignment of Mask M and the sensitization substrate P, performed the statistics operation to the acquired positional information, and were set up on the sensitization substrate P. And based on the positional information and the ideal location (ideal grid) for which it asked, the deformation of the characteristic of image of a pattern, i.e., a shift, rotation, a scaling, as a result the sensitization substrate P is calculated. and the shift adjustment device 23 which projection optics PL1-PL5 is alike, respectively, and is established to the pattern currently previously formed in the sensitization substrate P so that the following pattern can be accumulated by position relation, the rotation adjustment devices 28 and 31, and the scaling adjustment device 27 -- the each amount of amendments of drives, i.e., the amount of the driving gear which drives each [these] adjustment device, is set up. And scan exposure can be performed, amending the characteristic of image based on the amount of amendments of each set-up adjustment device. Even if a pattern image (projection field) may shift to a desired location by carrying out like this on the sensitization substrate P by adjustment of the image surface adjusting device 10, a pattern image can be projected on a desired location by amending a pattern image using the above-mentioned

adjustment device.
[0135] In addition, in case shift adjustment is performed, for example, as shown in drawing 14 (a), as shown in drawing 14 (b), projection field 50a on the sensitization substrate P (50b-50e) can shift the image surface adjusting-device 10 whole to X shaft orientations only for the shift-amount X50a according to the angle of rotation theta of the image surface adjusting device 10 by rotating to the circumference of a Y-axis, without using the shift adjustment device 23. Moreover, passing speed (movement magnitude per unit time amount) VX50of projection field 50a at this time a is based on rotational-speed (rotation per unit time amount) Vtheta of the image surface adjusting device 10.
[0136] With the above-mentioned operation gestalt, although the image surface adjusting device 10 is a configuration prepared between the reflective refraction mold optical system 24 and the reflective refraction mold optical system 25, as shown in drawing 15 , the image surface adjusting device 10 may be formed near the mask M. Or the image surface adjusting device 10 may be formed near the sensitization substrate P. Furthermore, the image surface adjusting device 10 may be formed near Mask M and the sensitization substrate P.
[0137] As shown in drawing 16 , the mark 60 for image formation location detection of projection optics can be formed in the 1st optical member 1 or the 2nd optical member 2 among the image surface adjusting devices 10. The image surface adjusting device 10 is formed in the location [**** / optical almost] to Mask M and the sensitization substrate P, and can ask for the image formation location of projection optics by detecting this mark 60 for image formation location detection by the image pick-up sensor 41. For example, moving the image pick-up sensor 41 to Z shaft orientations with the substrate stage PST, the mark 60 for image formation location detection is detected, and when it is a circle configuration, a location [in / in the mark 60 for image formation location detection / Z shaft orientations of the image pick-up sensor 41 by which an image serves as a diameter of min] turns into an image formation location of projection optics.
[0138] In addition, although the aligner EX in the above-mentioned operation gestalt is the so-called multi-lens scanning aligner which has two or more projection optics which adjoins mutually, scanning aligner ****** the number of projection optics is [******] one can also apply this invention.
[0139] In addition, it can carry out suitable also to the aligner for semi-conductor manufacture, and the aligner for manufacturing the thin film magnetic head widely, for example, without being limited to the aligner for liquid crystal which exposes a liquid crystal display component pattern on the glass plate of a square shape as an application of Aligner EX.
[0140] g line (436nm), h line (405nm), and not only i line (365nm) but KrF excimer laser (248nm), ArF excimer laser (193nm), and F2 laser (157nm) can be used for the light source of the aligner EX of this operation gestalt.
[0141] Any of not only unit systems but a contraction system and an expansion system are sufficient as the scale factor of projection optics PL.
[0142] Using the ingredient which penetrates the far ultraviolet rays of a quartz, fluorite, etc. as ** material as projection optics PL when using far ultraviolet rays, such as excimer laser, when using F2 laser, it is made the optical system of reflective refractive media or refractive media.
[0143] When using a linear motor for the substrate stage PST and a mask stage MST, whichever of the magnetic levitation mold using the air surfacing mold and the Lorentz force, or the reactance force which air bearing was used may be used. Moreover, the type which moves along with a guide is sufficient as a stage, and the guide loess type which does not prepare a guide is sufficient as it.
[0144] What is necessary is to connect a magnet unit or an armature unit to a stage, and just to establish another side of a magnet unit and an armature unit in the migration side side (base) of a stage, when using a flat-surface motor as a driving gear of a stage.
[0145] The reaction force generated by migration of the substrate stage PST may be mechanically missed to the floor (earth) using a frame member as indicated by JP,8-166475,A. This invention is applicable also in the aligner equipped with such structure.
[0146] The reaction force generated by migration of a mask stage MST may be mechanically missed to the floor (earth) using a frame member as indicated by JP,8-330224,A. This invention is applicable also in the aligner equipped with such structure.
[0147] as mentioned above, the aligner of this application operation gestalt -- this application -- it is

manufactured by assembling the various subsystems containing each component mentioned to the claim so that a predetermined mechanical precision, electric precision, and optical precision may be maintained. In order to secure these various precision, before and after this assembly, adjustment for attaining electric precision is performed about the adjustment for attaining mechanical precision about the adjustment for attaining optical precision about various optical system, and various mechanical systems, and various electric systems. Like the assembler from various subsystems to an aligner, the mechanical connections between [various] subsystems, wiring connection of an electrical circuit, piping connection of an atmospheric-pressure circuit, etc. are included. It cannot be overemphasized that it is in the front like the assembler from these various subsystems to an aligner like the assembler of each subsystem each. If it ends like the assembler to the aligner of various subsystems, comprehensive adjustment will be performed and the various precision as the whole aligner will be secured. In addition, as for manufacture of an aligner, it is desirable to carry out in the clean room where temperature, an air cleanliness class, etc. were managed.

[0148] step 201 to which a semiconductor device performs the function and engine-performance design of a device as shown in drawing 17 , step 202 which manufactures the mask (reticle) based on this design step, and the substrate (a wafer --) it is [substrate] the base material of a device step 203 which manufactures a glass plate, the wafer processing step 204 which exposes the pattern of a reticle to a wafer with the aligner of the operation gestalt mentioned above, and a device assembly step (a dicing process --) It is manufactured through 205 and inspection step 206 grade including a bonding process and a package process.

[0149]

[Effect of the Invention] Since according to this invention the image surface inclination of a pattern image was adjusted while adjusting the location of the image surface of a pattern in the direction which intersects perpendicularly with this image surface, it can continue throughout a sensitization substrate and scan exposure can be performed in the condition near the optimal focus. Therefore, it is highly precise and a reliable device can be manufactured by low cost.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline block diagram showing 1 operation gestalt of the aligner of this invention.
[Drawing 2] It is the outline perspective view of the aligner shown in drawing 1 .
[Drawing 3] It is the outline block diagram showing projection optics.
[Drawing 4] It is a top view for explaining a sensitization substrate and a projection field.
[Drawing 5] It is drawing showing an image surface adjusting device, and (a) is a side elevation and (b) is a top view.
[Drawing 6] It is drawing showing the non-contact equipment formed in the image surface adjusting device.
[Drawing 7] It is drawing for explaining signs that an image formation location changes by adjusting the location of the 1st optical member and the 2nd optical member.
[Drawing 8] It is drawing for explaining signs that the location of the image surface changes by adjusting the location of the 1st optical member and the 2nd optical member.
[Drawing 9] It is a flow chart Fig. for explaining the 1st operation gestalt of the exposure approach of this invention.
[Drawing 10] It is drawing for explaining signs that the location of the image surface is adjusted by the image surface adjusting device.
[Drawing 11] It is drawing for explaining signs that the location of the image surface is adjusted by the image surface adjusting device.
[Drawing 12] It is drawing for explaining signs that the location of the image surface is adjusted by the image surface adjusting device.
[Drawing 13] It is a flow chart Fig. for explaining the 2nd operation gestalt of the exposure approach of this invention.
[Drawing 14] It is drawing for explaining signs that a pattern image shifts by driving an image surface adjusting device.
[Drawing 15] It is the outline block diagram showing other examples of projection optics.
[Drawing 16] It is drawing for explaining the mark for image formation location detection prepared in the image surface adjusting device.
[Drawing 17] It is the flow chart Fig. showing an example of the production process of a semiconductor device.
[Description of Notations]
1 1st Optical Member (1st Optical Member)
1b The 1st injection side (the 1st inclined plane)
2 2nd Optical Member (2nd Optical Member)
2a The 2nd plane of incidence (the 2nd inclined plane)
5 Six Linear actuator (a driving gear, slewing gear)
10 Image Surface Adjusting Device
11 Air Bearing (Non-contact Equipment)
41 Image Pick-up Sensor
CONT Control unit (control section)
EX Aligner

M Mask
P Sensitization substrate
PL1-PL5 Projection optics
PST Substrate stage

[Translation done.]

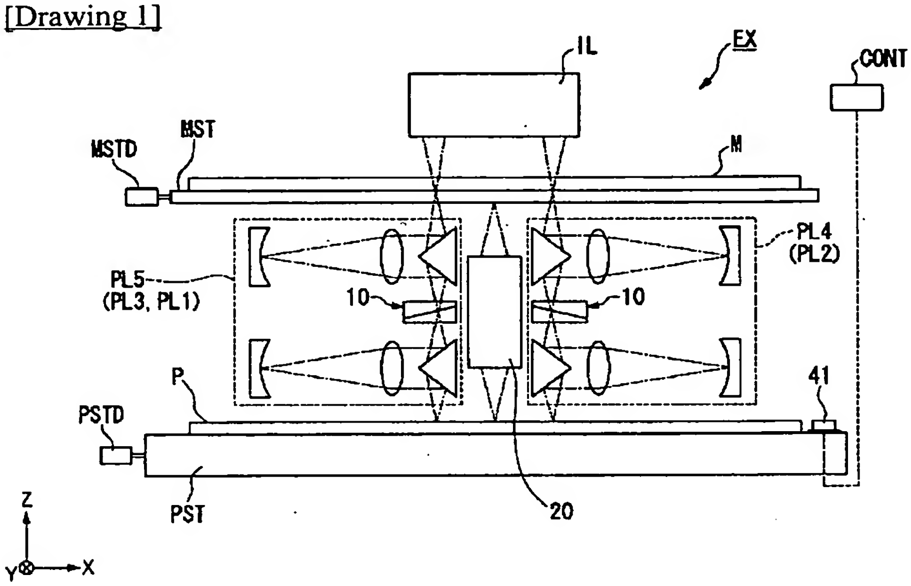
* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

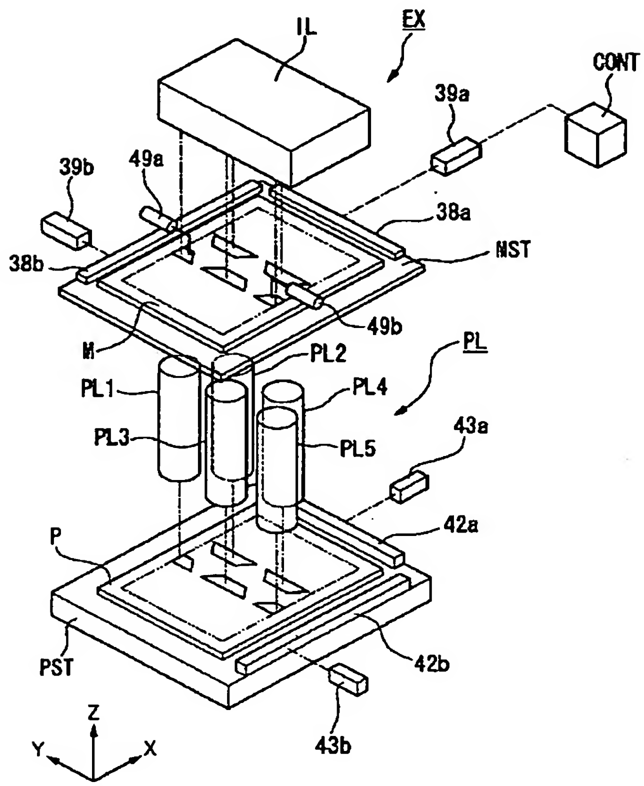
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

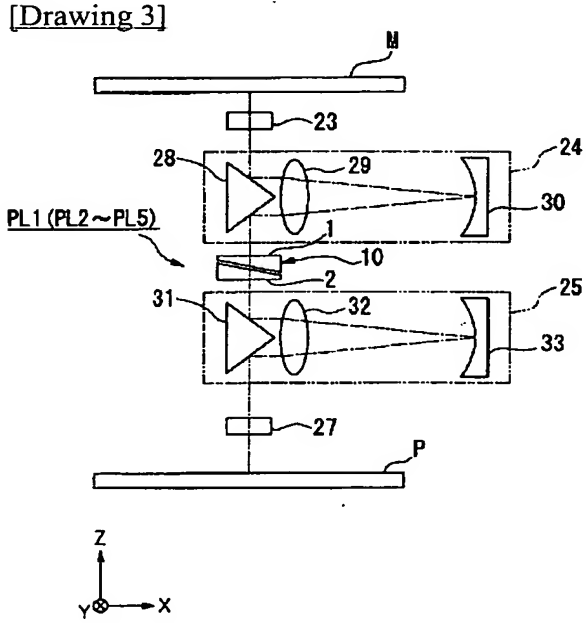
[Drawing 1]



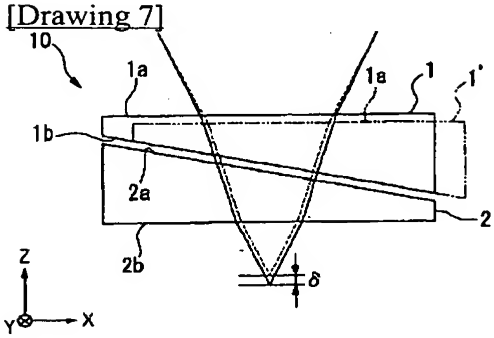
[Drawing 2]



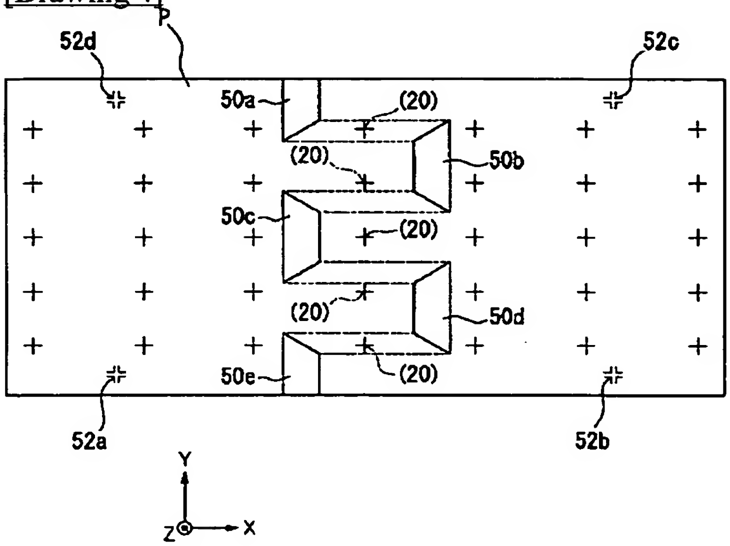
[Drawing 3]



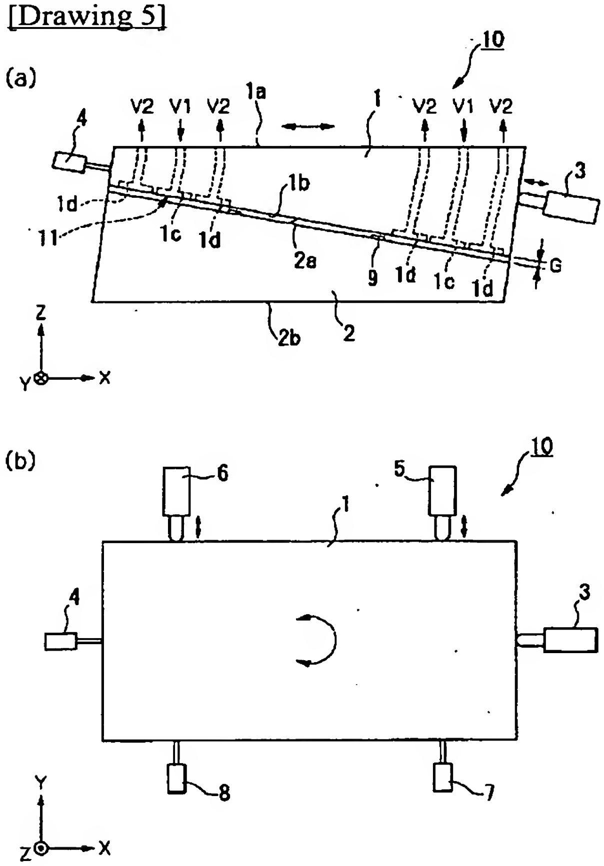
[Drawing 7]



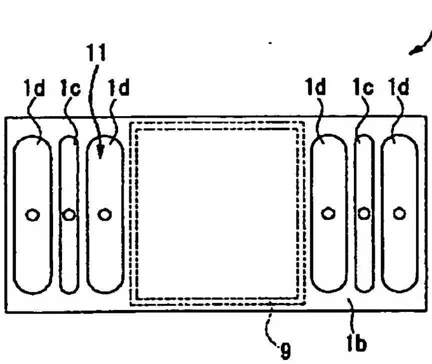
[Drawing 4]



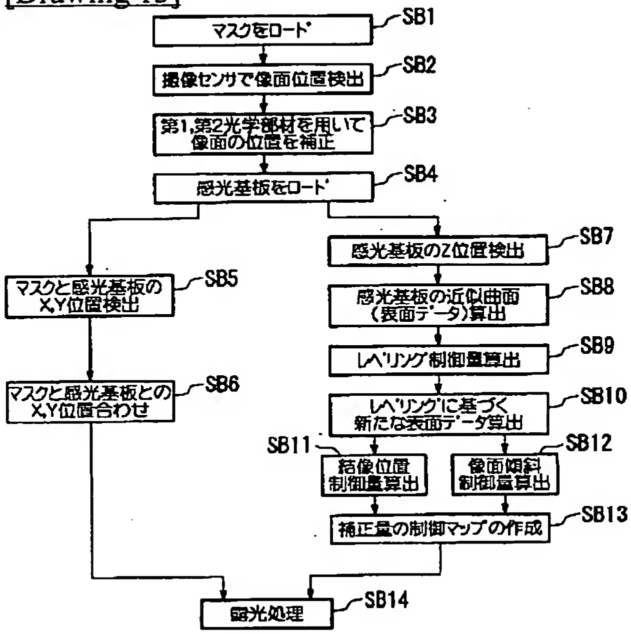
[Drawing 5]



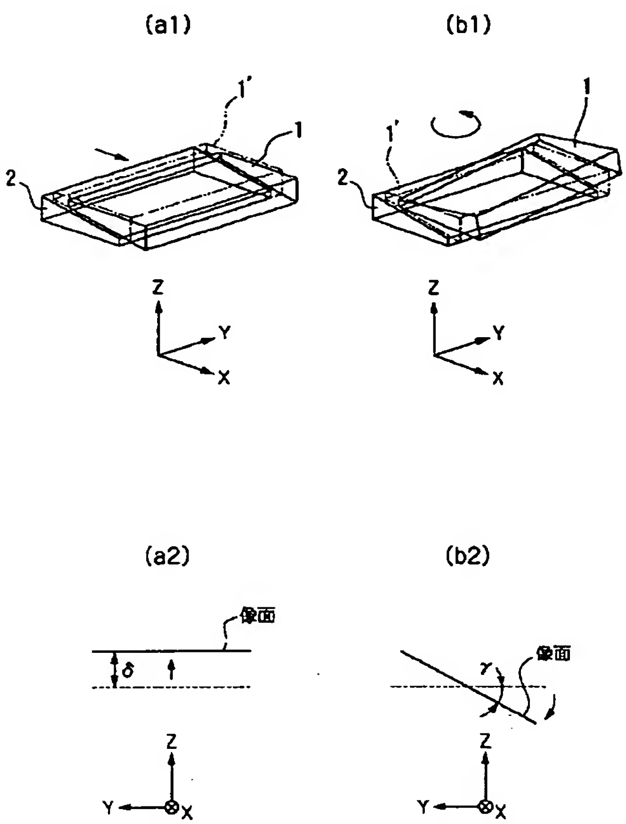
[Drawing 6]



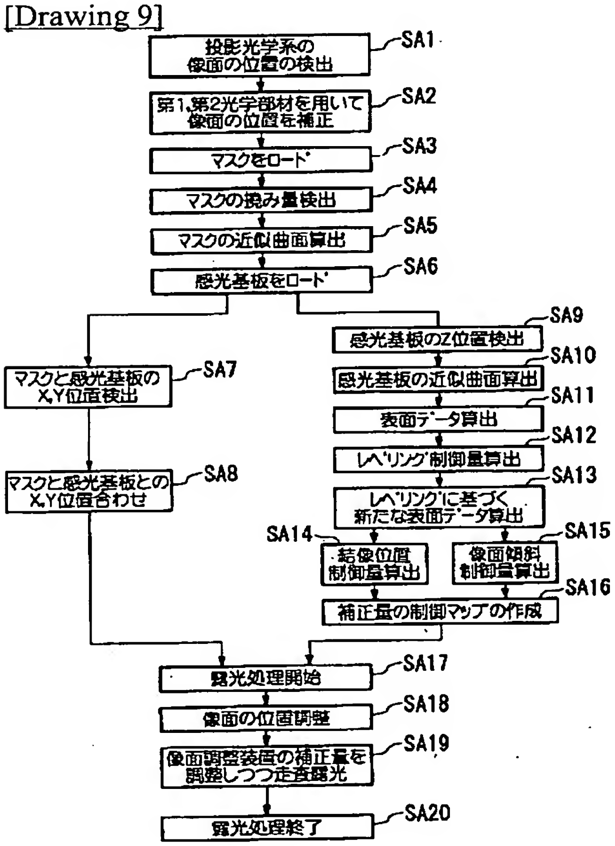
[Drawing 13]



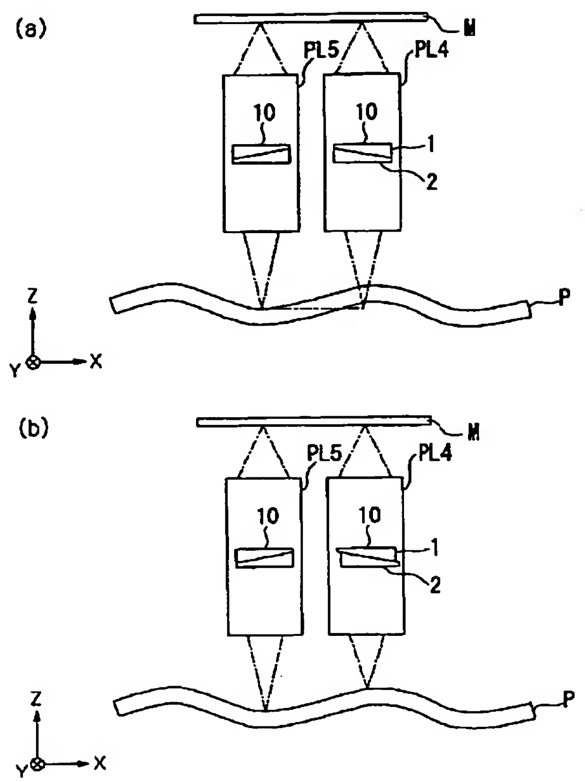
[Drawing 8]



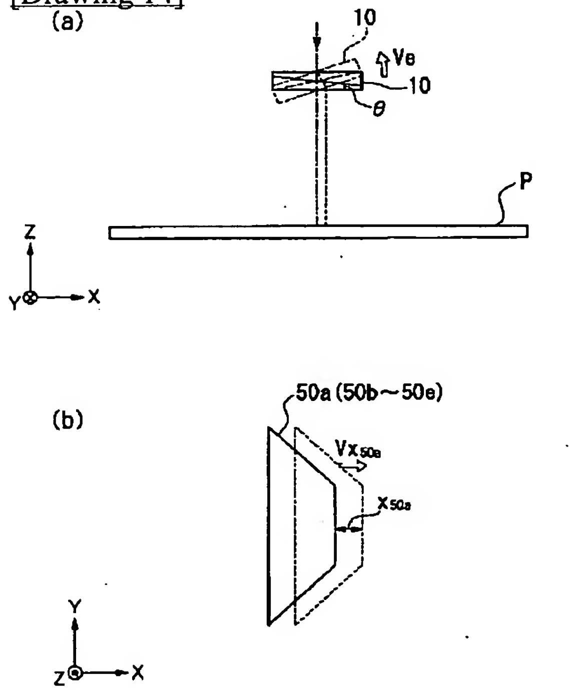
[Drawing 9]



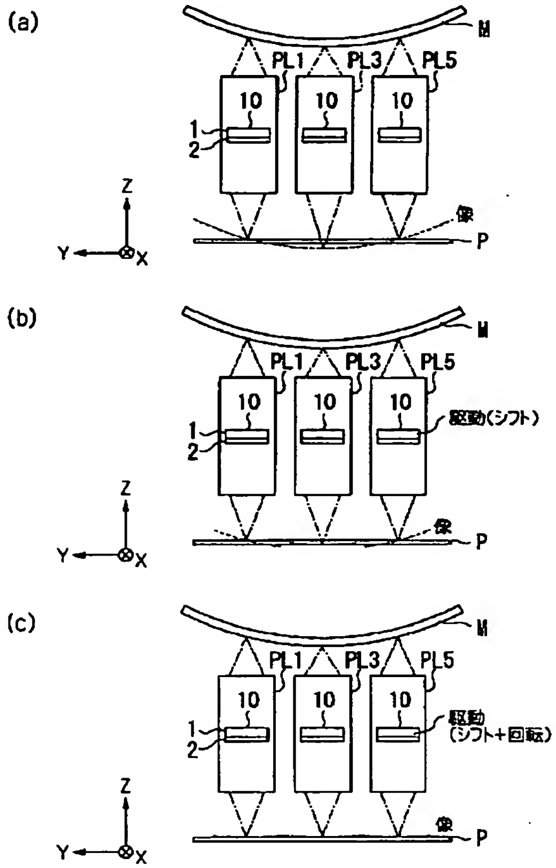
[Drawing 11]



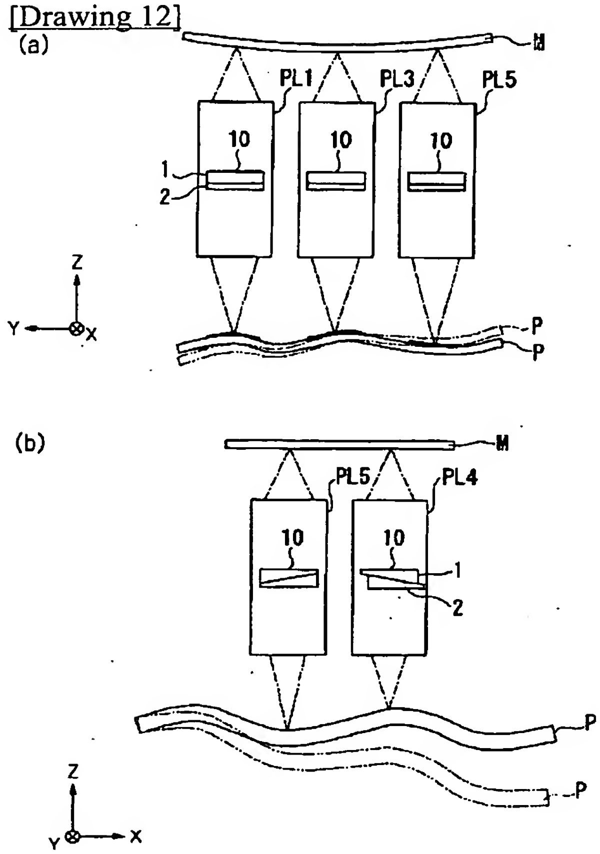
[Drawing 14]



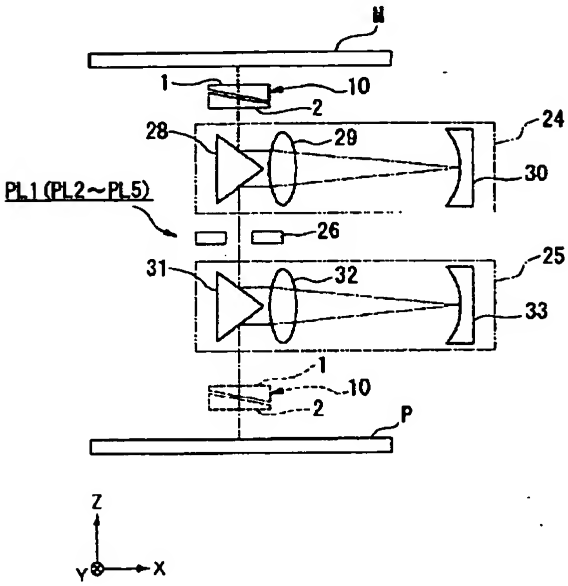
[Drawing 10]



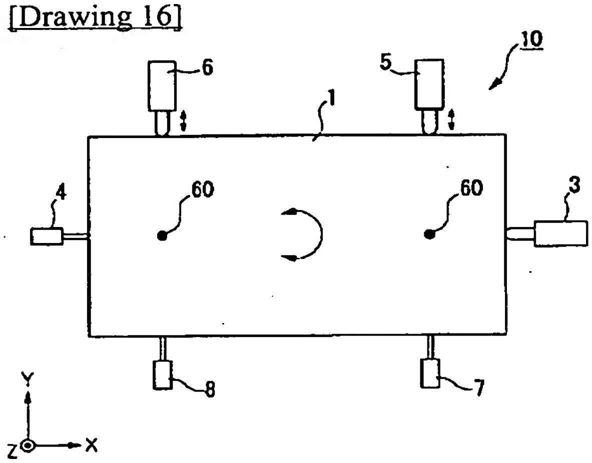
[Drawing 12]



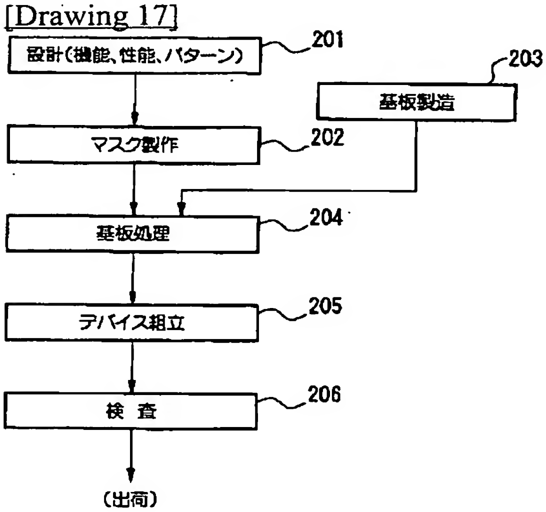
[Drawing 15]



[Drawing 16]



[Drawing 17]



[Translation done.]